GANDHI INSTITUTE OF TECHNOLOGY AND MANAGEMENT (GITAM)

(Deemed to be University)

VISAKHAPATNAM * HYDERABAD * BENGALURU

Accredited by NAAC with A++ Grade

GITAM School of Technology

CURRICULUM AND SYLLABUS

4 Year Undergraduate Programme
UEECE02: B.Tech. Electrical and Electronics Engineering

w.e.f. 2023-24 admitted batch

(Updated on 31st July 2023)

Academic Regulations

Applicable for the Undergraduate Programmes in the Schools of Business, Humanities & Social Sciences, Science, Technology

https://www.gitam.edu/academic-regulations

Vision

To become a global leader in higher education.

Mission

To impart futuristic and comprehensive education of global standards with a high sense of discipline and social relevance in a serene and invigorating environment.

Quality Policy

To achieve global standards and excellence in teaching, research, and consultancy by creating an environment in which the faculty and students share a passion for creating, sharing and applying knowledge to continuously improve the quality of education.

VISION AND MISSION OF THE SCHOOL

VISION

To become a global leader in holistic engineering education and research

MISSION

1. To impart a strong academic foundation and practical education through a flexible curriculum, state-of-the-art infrastructure, and best learning resources
2. To actively pursue academic and collaborative research with industries and research institutions, both in India and abroad
3. To build a congenial and innovative eco system by enabling the latest technologies, thus helping the students, to solve the challenges of societal importance
4. To provide our students with the appropriate leadership, management, communication skills and professional ethics for career success and to continuously impact the global lives

UEECE02: B.Tech. Electrical and Electronics Engineering

(w.e.f. academic year 2023-24 admitted batch)

Programme Educational Objectives (PEOs)

PEO 1 To impart knowledge of mathematics and science concepts as tools to device and deliver efficient solutions to problems of Electrical and Electronics Engineering

PEO 2 To inculcate analytical ability in the students to keep pace with changing technologies and to imbibe skill and research culture to meet the industrial and societal needs.

PEO 3 To provide a platform for the graduate to be successful in technical and professional careers or develop as an entrepreneur.

PEO 4 To instill teamwork, leadership, and communication skills in the student with professional, ethical, and human values to be responsible citizen of the society.

Mapping of the Mission of the School with the PEOs

	PEO1	PEO2	PEO3	PEO4
M1	H	M	L	L
M2	L	H	M	L
M3	M	L	M	L
M4	L	L	H	H

H – High, M – Medium, L – Low

Programme Outcomes (POs) and Programme Specific Outcomes (PSOs):

At the end of the Programme the students would be able to:

PO1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12	Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO1	Design and develop electrical, control and power systems for engineering applications in the fields of electrical appliances, industrial automation, power distribution and allied interdisciplinary areas.
PSO2	Demonstrate the use of modern tools and techniques for solving contemporary real-world problems in electrical and electronics engineering
PSO3	Research and devise appropriate technologies for implementation of the electrical and power systems as an entrepreneur/researcher with professional ethics & concern for societal wellbeing

Curriculum Structure

(Flexible Credit System)

UNIVERSITY CORE (UC)								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
CSEN1001	1	IT Productivity Tools^	0	0	2	0	0	1*
CLAD1001	1	Emotional Intelligence & Reasoning Skills (Soft Skills 1)	0	0	2	0	0	1
CLAD1011	1	Leadership Skills & Quantitative Aptitude (Soft Skills 2)	0	0	2	0	0	1
CLAD1021	1	Verbal Ability & Quantitative Ability (Soft Skills 3)	0	0	2	0	0	1
CLAD1031	1	Practicing Verbal Ability & Quantitative Aptitude (Soft Skills 4)	0	0	2	0	0	1
CLAD20XX	2	Soft skills 5A/5B/5C	0	0	2	0	0	1
CLAD20XX	2	Soft skills 6A/6B/6C	0	0	2	0	0	1
DOSP10XX	1	Sports 1#	0	0	0	2	0	2*
DOSL10XX	1	Club Activity#	0	0	0	2	0	2*
DOSL10XX	1	Community Service#	0	0	0	0	2	2*
ENVS1001	1	Environmental Studies^	3	0	0	0	0	3*
FINA3001	3	Personal Financial Planning#	0	0	2	0	0	1*
LANG1012	1	Communication Skills In English – Intermediate	0	0	4	0	0	2
LANG1022	1	Communication Skills In English – Advanced	0	0	4	0	0	2
MFST1001	1	Health and Wellbeing#	0	0	2	0	0	1*
POLS1001	1	Indian Constitution and History	2	0	0	0	0	2*
PHPY1001	1	Gandhi for the 21st Century	2	0	0	0	0	2*
VEDC1001	1	Venture Development	0	0	0	2	0	2

* Pass/Fail courses
# Opt any two courses among the five
^ Online/Swayam/NPTEL Courses

Soft skills courses 5 and 6								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
CLAD2001	2	Preparation for Campus Placement-1 (Soft skills 5A)	0	0	2	0	0	1
CLAD2011	2	Preparation for Higher Education (GRE/ GMAT)-1 (Soft skills 5B)	0	0	2	0	0	1
CLAD2021	2	Preparation for CAT/ MAT – 1 (Soft skills 5C)	0	0	2	0	0	1
CLAD2031	2	Preparation for Campus Placement-2 (Soft skills 6A)	0	0	2	0	0	1
CLAD2041	2	Preparation for Higher Education (GRE/ GMAT)-2 (Soft skills 6B)	0	0	2	0	0	1
CLAD2051	2	Preparation for CAT/ MAT – 2 (Soft skills 6C)	0	0	2	0	0	1

Sports Courses								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
DOSP1001	1	Badminton	0	0	0	2	0	2
DOSP1011	1	Chess	0	0	0	2	0	2
DOSP1021	1	Carrom	0	0	0	2	0	2
DOSP1031	1	Football	0	0	0	2	0	2
DOSP1041	1	Volleyball	0	0	0	2	0	2
DOSP1051	1	Kabaddi	0	0	0	2	0	2
DOSP1061	1	Kho Kho	0	0	0	2	0	2
DOSP1071	1	Table Tennis	0	0	0	2	0	2
DOSP1081	1	Handball	0	0	0	2	0	2
DOSP1091	1	Basketball	0	0	0	2	0	2
DOSP1101	1	Tennis	0	0	0	2	0	2
DOSP1111	1	Throwball	0	0	0	2	0	2

Club Activity Courses								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
DOSL1001	1	Club Activity (Participant)	0	0	0	2	0	2
DOSL1011	1	Club Activity (Member of the Club)	0	0	0	2	0	2
DOSL1021	1	Club Activity (Leader of the Club)	0	0	0	2	0	2
DOSL1031	1	Club Activity (Competitor)	0	0	0	2	0	2
Community Service courses								

Course code	Level	Course title	L	T	P	S	J	C
DOSL1041	1	Community Services – Volunteer	0	0	0	0	2	2
DOSL1051	1	Community Services – Mobilizer	0	0	0	0	2	2

FACULTY CORE (FC)

Course code	Level	Course title	L	T	P	S	J	C
CHEM1001	1	Chemistry	2	1	2	0	0	4
CSEN1011	1	Problem Solving and Programming with C	0	0	6	0	0	3
CSEN1021	1	Programming with Python	0	0	6	0	0	3
CSEN1031	1	Artificial Intelligence Applications	0	0	2	0	0	1
EECE1001	1	Basic Electrical and Electronics Engineering	2	1	2	0	0	4
HSMCH102	1	Universal Human Values*	3	0	0	0	0	3
INTN2333	2	Internship 1*	0	0	0	0	1	1
INTN3444	3	Internship 2	0	0	0	0	1	3
MATHXXXX	X	Mathematics Basket 1	2	0	0	0	0	2
MATHXXXX	X	Mathematics Basket 2	2	0	0	0	0	2
MATHXXXX	X	Mathematics Basket 3	2	0	0	0	0	2
MATHXXXX	X	Mathematics Basket 4	2	0	0	0	0	2
MATHXXXX	X	Mathematics Basket 5	2	0	0	0	0	2
MATHXXXX	X	Mathematics Basket 6	2	0	0	0	0	2
MATH2361	2	Probability and Statistics	3	0	0	0	0	3
MECH1011	1	Engineering Visualization and Product Realization	0	0	4	0	0	2
MECH1041	1	Technology Exploration & Product Engineering	0	0	4	0	0	2
MECH1001	1	Design Thinking	0	0	2	0	0	1
PHYS1001	1	Physics	2	1	2	0	0	4
PHYSXXXX	1	Physics Basket	3	1	0	0	0	4
PROJ2999	2	Capstone Project – Introduction	0	0	0	0	2	2
PROJ3999	3	Capstone Project – Final	0	0	0	0	6	6
PROJ2888	2	Project Exhibition 1*	0	0	0	0	1	1
PROJ3888	3	Project Exhibition 2*	0	0	0	0	1	1
VIVA3555	3	Comprehensive Examination*	1	0	0	0	0	1
XXXXXXXX	X	Management Basket	3	0	0	0	0	3

*Pass/Fail mandatory courses

Mathematics Basket								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
MATH1001	1	Single Variable Calculus	2	0	0	0	0	2
MATH1011	1	Several Variable Calculus	2	0	0	0	0	2
MATH2371	2	Difference Equations	2	0	0	0	0	2
MATH1031	1	Differential Equations	2	0	0	0	0	2
MATH2281	2	Numerical techniques	2	0	0	0	0	2
MATH1021	1	Transform Techniques	2	0	0	0	0	2
MATH2381	2	Operations Research	2	0	0	0	0	2
MATH2301	2	Complex Variables	2	0	0	0	0	2
MATH1041	1	Discrete Mathematics	2	0	0	0	0	2
MATH1051	1	Graph Theory	2	0	0	0	0	2
MATH2311	2	Number Theory	2	0	0	0	0	2
MATH2291	2	Linear Algebra	2	0	0	0	0	2
MATH2341	2	Probability Theory and Random Variables	2	0	0	0	0	2
MATH2321	2	Random Processes	2	0	0	0	0	2
MATH2351	2	Optimization Methods	2	0	0	0	0	2
MATH2331	2	Computational Methods	2	0	0	0	0	2
MATH1061	1	Introduction to Mathematics – I	2	0	0	0	0	2
MATH1071	1	Introduction to Mathematics – II	2	0	0	0	0	2
MATH2361	2	Probability and Statistics	3	0	0	0	0	3
Physics Basket								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
PHYS1001	1	Physics	2	1	2	0	0	4
PHYS1011	1	Mechanics and Properties of Matter	3	1	0	0	0	4
PHYS1021	1	Principles of Quantum Mechanics	3	1	0	0	0	4
PHYS1031	1	Physics of Semi Conducting devices	3	1	0	0	0	4
PHYS1041	1	Mechanics and Modern Physics	3	1	0	0	0	4
Management Basket								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
FINA1031	1	Principles and Practice of Banking	3	0	0	0	0	3
HRMG1021	1	Human Resource Management	3	0	0	0	0	3
MKTG3011	3	Sales and Distribution Management	3	0	0	0	0	3

Programme Core (PC)

Course code	Level	Course Title	L	T	P	S	J	C
EECE1051	1	Electrical Workshop	0	0	2	0	0	1
EECE1021	1	Signals and Systems	2	1	0	0	0	3
EECE1061	1	Electrical Circuit Analysis	2	1	2	0	0	4
EECE1041	1	Electronic Devices and Amplifier Circuits	3	0	2	0	0	4
EECE2061	2	Electromagnetic Fields	3	0	0	0	0	3
EECE2021	2	Digital Logic Design	3	0	2	0	0	4
EECE2031	2	Analog Circuits	3	0	2	0	0	4
EECE2071	2	Linear Control Systems	2	0	2	0	0	3
EECE2081	2	DC Machines and Transformers	2	0	2	0	0	3
EECE3061	3	Electrical Measurements	2	0	2	0	0	3
EECE3071	3	AC Machines	3	0	2	0	0	4
EECE3081	3	Electrical power generation transmission and distribution	2	1	0	0	0	3
EECE3041	3	Microprocessors and Microcontrollers	3	0	2	0	0	4
EECE3091	3	Power System Analysis	2	1	0	0	0	3
EECE3101	3	Power Electronics	2	0	2	0	0	3
EECE3111	3	Power System Protection	2	0	2	0	0	3

Programme Elective (PE)

Course code	Level	Course Title	L	T	P	S	J	C
EECE1071	1	Battery Technologies	3	0	0	0	0	3
EECE2191	2	Fundamentals of Autonomous Vehicles	3	0	0	0	0	3
EECE3391	3	Electrical Machine Design	3	0	0	0	0	3
EECE3401	3	Electrical Distribution systems	3	0	0	0	0	3
EECE3411	3	High Voltage Engineering	3	0	0	0	0	3
EECE3421	3	Wind & Solar Energy Systems	3	0	0	0	0	3
EECE4101	4	Artificial Intelligence application to power systems	3	0	0	0	0	3
EECE3431	3	Electrical Drives	3	0	0	0	0	3
EECE3441	3	Industrial Electrical Systems	3	0	0	0	0	3
EECE3451	3	Power Quality & FACTS	3	0	0	0	0	3
EECE3461	3	HVDC Transmission systems	3	0	0	0	0	3

EECE4111	4	Hybrid Electric Vehicles	3	0	0	0	0	3
EECE3471	3	Process Control and Automation	3	0	0	0	0	3
EECE3481	3	Digital Control systems	3	0	0	0	0	3
EECE4121	4	Advanced Control systems	3	0	0	0	0	3
EECE3491	3	Modern control systems	3	0	0	0	0	3
EECE4131	4	Non -linear control systems	3	0	0	0	0	3
EECE3501	3	Robotics	3	0	0	0	0	3
EECE3511	3	Robot Kinematics and Dynamics	2	0	2	0	0	3
EECE3521	3	Robot Motion Planning and Control	3	0	2	0	0	3
EECE3531	3	Robot Simulation Using Open-Source Tools	3	0	2	0	0	3
EECE3541	3	Robotic Operating Systems	3	0	2	0	0	3
EECE3551	3	Embedded System Design and Development	3	0	0	0	0	3
EECE3561	3	Computer Vision	3	0	2	0	0	3
EECE4141	4	Introduction to AI in Robotics	3	0	2	0	0	3
EECE4151	4	Introduction to ML in Robotics	3	0	2	0	0	3
EECE3571	3	Smart Grid Architectural Design	3	0	0	0	0	3
EECE3581	3	Fundamentals of power systems	3	0	0	0	0	3
EECE3591	3	Renewable Energy Systems	3	0	0	0	0	3
EECE3601	3	Smart grid communication systems	3	0	0	0	0	3
EECE4161	4	Energy management in smart grids	3	0	0	0	0	3
EECE3611	3	Security Issues in Smart Grids	3	0	0	0	0	3
EECE3621	3	Introduction to Electric Vehicle Technology	3	0	0	0	0	3
EECE3631	3	Sensors and Communications in Electric Vehicles	3	0	0	0	0	3
EECE3641	3	Vehicle Dynamics, Modelling and Simulations	3	0	0	0	0	3
EECE3651	3	Electrical Drives and Control for Electrical Vehicles	3	0	0	0	0	3
EECE4171	4	Battery management system	3	0	0	0	0	3
EECE4181	4	Self-Driving Vehicle Technology	3	0	0	0	0	3
# Opt eligible PC/PE courses from other programmes as an open elective course and earn 24 credits								

PROGRAMME STRUCTURE

BTech Programme consists of courses which could be grouped under University Core (UC), Faculty Core (FC), Major/Programme Core (PC), Major/Programme Electives (PE) and Open Electives (OE) as the below breakup.

Category	Credits	% of Program (in credits)
University Core (UC)	12	8%
Faculty Core (FC)	57	35%
Programme Core (PC)	52	33%
Programme Electives (PE)	15	9%
Open Electives (OE)	24	15%
Total	**160**	

Courses offered under University Core are common to all undergraduate level programmes offered by GITAM. Courses offered under Faculty core are common to all BTech programmes offered by GITAM and are meant to acquaint the student with general engineering principles in all disciplines of engineering. Based on the chosen BTech Programme, the student shall complete courses under Program Core (specific to be chosen branch of engineering).

Each course is assigned a certain number of credits depending upon the number of contact hours (lectures/tutorials/practical) per week. In general,

- **Theory:** A student attending classroom lecture/ tutorial/ skill development activity of 50 minutes' duration per week, spread over the entire semester is awarded one credit.
- **Practical:** A student attending a minimum of 100 minutes per week of laboratory session/ practical is awarded - one credit.
- **Project Work:** A student working for 50 minutes of project work per week with 3 hours of work performed independent of the instructor during the entire semester is awarded - one credit
- **Internship:** 8 hours in a day for four weeks is required for earning internship credits

Course PO Mapping

Course Code	Course Name	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
LANG1012	Communication Skills In English – Intermediate									L	M		M			
LANG1022	Communication Skills In English – Advanced									L	H					
CLAD1001	Soft Skills 1 - Emotional Intelligence & Reasoning Skills								H	M	M		L			
CLAD1011	Soft Skills 2 - Leadership Skills & Quantitative Aptitude								H	L	M		L			
CLAD1021	Soft Skills 3 - Verbal Ability & Quantitative Ability								L	M	M		L			
CLAD1031	Soft Skills 4 - Practicing Verbal Ability & Quantitative Aptitude								L	M	H	L	L			
CLAD1041	Soft Skills 5A - Preparation for Campus Placement								L		H		M			
	Soft Skills 5B - Preparation For Higher Education (GRE/ GMAT)								M		H		L			
	Soft Skills 5C - Preparation for CAT/ MAT								M		H		L			
CLAD1051	Soft Skills 6A – Preparation for Campus Placement								M	M	H		H			
	Soft Skills 6B – Preparation For Higher Education (GRE/ GMAT)								M		H		L			
	Soft Skills 6C– Preparation for CAT/ MAT								M		H		M			
VEDC1001	Venture Development								M	M	M	H	L			

DOSP10XX	Sports 1								M	L			H			
DOSL10XX	Club Activity								L	M			H			
POLS1001	Indian Constitution and History								L		L		M			
PHPY1001	Gandhian Values/ Ethics								H		L		M			
DOSL10XX	Community Service								M		L		H			
ENVS1001	Environmental Studies			L				H					M			
FINA3001	Financial and Tax Literacy / Personal Financial Planning								H	L	L		M			
MFST1001	Health and Wellbeing									M		L	M			
CSEN1001	IT Productivity Tools				M	H							L			
MATHXX	Maths Basket 1	H	M													
MATHXX	Maths Basket 2	L	H	M												
MATHXXX	Maths Basket 3	L	H	M												
MATHXXX	Maths Basket 4	L		H	M											
MATHXXX	Maths Basket 5	L		H	M											
MATHXXX	Maths Basket 6	L			H	M										
MATH2361	Probability and Statistics	L			H	M									L	
PHYS1001	Physics	H	M						L							
PHYS1XXX	Physics Basket	M	H						L							
CHEM1001	Chemistry		H					M	L							
MECH1011	Engineering Visualization and Product Realization	L	M	H			L									
MECH1041	Technology Exploration & Product Engineering				H	M	L									
MECH1001	Design Thinking	L		M	H		L							L		
EECE1001	Basic Electrical and Electronics Engineering	H	M	L										L		
CSEN1011	Problem Solving and Programming with C		H	L		M								M		
CSEN1021	Programming with Python		M			H						L	L		M	
CSEN1031	Applications of Artificial Intelligence	M				H	L						L	L	M	
XXXXXX	Management Basket								L	M	M		H			
INTN2333	Internship 1									L	H		M		M	
INTN3444	Internship 2									L	H		M		M	

VIVA3555	Comprehensive Examination									L	H		M			
PROJ2999	Capstone Project - Introduction			M						M	H	H	L			M
PROJ3999	Capstone Project - Final			M						M	H	H	L			M
HSMCH102	Universal Human Values								H		L		M			
PROJ2888	Project Exhibition 1	M								M	H	H	L			M
PROJ3888	Project Exhibition 2	M								M	H	H	L			M
EECE1051	Electrical Workshop	M		M	L									L		
EECE1021	Signals and Systems	M	H	L	M									L	M	
EECE1061	Electrical Circuit Analysis	M	H	M	L	M								M		
EECE1041	Electronic Devices and Amplifier Circuits	M	H	L	L									M		
EECE2061	Electromagnetic Fields	M	H	L	L	M								M		
EECE2021	Digital Logic Design	M	M	M	L	M								L		
EECE2031	Analog Circuits	M	M	L	M	M								M		
EECE2071	Linear Control Systems	M	M	L	M	M								M	L	M
EECE2081	DC Machines and Transformers	M	M	L	L	M	M							M		L
EECE2191	Fundamentals Of Autonomous Vehicles	M	M	L	M			H	L					M		H
EECE3061	Electrical Measurements	M	M	L	L	M	M							M		L
EECE3071	AC Machines	M	M	L	L	M	M							M		M
EECE3081	Electrical power generation transmission and distribution	M	L	M	H	M	M	M						M	L	H
EECE3041	Microprocessors and Microcontrollers	M	M	M	M	M								M	M	M
EECE3091	Power system analysis	M	M	M	H	M		M						M		M
EECE3101	Power Electronics	M	M	M	H	M		L						M		M
EECE3111	Power System Protection	M	M	H	H	M	H		L					M		M
EECE3391	Electrical Machine Design	M	M	H	H	M								M		H
EECE3401	Electrical Distribution systems	M	M	M	H	M								M		H

EECE3411	High Voltage Engineering	M	M	M	M	M								M		M
EECE3421	Wind & Solar Energy Systems	M	H	H	H	H		H	L					M		H
EECE4101	Artificial Intelligence application to power systems	M	H	H	H	H		M					L	M		H
EECE3431	Electrical Drives	M	M	M	M	M								M		M
EECE3441	Industrial Electrical Systems	M	M	M	M	M								M		M
EECE3451	Power Quality & FACTS	M	M	M	H	M								M		H
EECE3461	HVDC Transmission systems	M	M	M	M	M								M		M
EECE4111	Hybrid Electric Vehicles	M	H	H	H	H		H	L					M		H
EECE3471	Process Control and Automation	M	M	L	M	M								M		M
EECE3481	Digital Control systems	M	M	L	M	M								M		M
EECE4121	Advanced Control systems	M	M	L	M	M								M		M
EECE3491	Modern control systems	M	M	L	M	M								M		M
EECE4131	Non -linear control systems	M	M	L	M	M								M		M
EECE3501	Robotics	M	M	M	M	H	M	L					M		H	M
EECE3511	Robot Kinematics and Dynamics	M	M	M	M	H	M	L					M		H	M
EECE3521	Robot Motion Planning and Control	M	M	M	M	H	M	L					M		H	M
EECE3531	Robot Simulation Using Open-Source Tools	M	M	M	M	H	M	L					M		H	M
EECE3541	Robotic Operating Systems	M	M	M	M	H	M	L					M		H	M
EECE3551	Embedded System Design and Development	M	M	M	M	H	M	L					M		H	M
EECE3561	Computer Vision	L	M	L	M	H							M		H	M
EECE4141	Introduction to AI in Robotics	M	H	M	H	H							M		H	M
EECE4151	Introduction to ML in Robotics	M	H	M	H	H							M		H	H

EECE3571	Smart Grid Architectural Design	M	H	M	H	H	M							M	H	M
EECE3581	Fundamentals of power systems	M	L	M	M		L						L	M		
EECE3591	Renewable Energy Systems	M	H	H	H	H		H	L					M		H
EECE3601	Smart grid communication systems	M	H	M	H	H	M							M	H	M
EECE4161	Energy management in Smart Grids	M	H	M	H	H	M							M	H	M
EECE3611	Security Issues in Smart Grids	L	M	L	M	H							M		H	M
EECE3621	Introduction to Electric Vehicle Technology	M	H	H	H	H		H	L					M		H
EECE3631	Sensors and Communications in Electric Vehicles	M	H	H	H	H		H	L					M		H
EECE3641	Vehicle Dynamics, Modeling and Simulations	M	H	H	H	H		H	L					M		H
EECE3651	Electrical Drives and Control for Electrical Vehicles	M	H	H	H	H		H	L					M		H
EECE4171	Battery management systems	M	H	H	H	H		M	L					M		L
EECE4181	Self-Driving Vehicle Technology	M	H	H	H	H		M	L					M		L

Syllabus

University Core

<table>
<tr><td rowspan="2">CSEN1001</td><td rowspan="2">IT Productivity Tools</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>0</td><td>0</td><td>1*</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Familiarity with Computer system and its operation.</td></tr>
</table>

Course Description:

This course introduces all software tools that improve the productivity of a student in enhancing his learning experience with all the activities taken up as part of his coursework.

Course Educational Objectives:

- To enable the learner, the skill in preparing technical documents of professional quality using docs, sheets and forms.
- To involve the student in designing and creating of websites and acquaint the student with the skill of processing audio, images, documents etc.
- To create awareness in analyzing data using pivot tables, query manager etc.
- To create awareness in composing emails, mail merge, e-mail merge etc.
- To provide the exposure to work with collaborative tools.

List of Experiments:

1. Create a typical document consisting of text, tables, pictures, multiple columns, with different page orientations.
2. Create a technical paper / technical report consisting of table of contents, table of figures,table of tables, bibliography, index, etc.
3. Compose and send customized mail / e-mail using mail-merge.
4. Create / modify a power point presentation with text, multimedia using templates withanimation.
5. Create spreadsheet with basic calculations with relative reference, absolute reference, andmixed reference methods.
6. Simple report preparation using filtering tool / advanced filtering commands / pivot tables in spreadsheet application.
7. Analyse the results of a examination student wise, teacher wise, course wise, institute-wise.
8. Collecting and consolidating data using collaborative tools like google docs, sheets, forms.
9. Create charts / pictures using online tools like: www.draw.io or smart draw
10. Create a website of his interest.

Textbooks:

1. Katherin Murray, 'Microsoft Office 365 Connect and collaborate virtually anywhere, anytime', Microsoft Press, ISBN: 978-0-7356-5694-9
2. EXCEL 2021 The Comprehensive Beginners to Advanced Users Guide to Master Microsoft Excel 2021. Learn the Essential Functions, New Features, Formulas, Tips and Tricks, and Many More
3. https://drawio-app.com/tutorials/video-tutorials/
4. Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and WebGraphics Fourth Edition ISBN-13: 978-1449319274

References/Online Resources:

1. https://www.coursera.org/learn/introduction-to-computers-and-office-productivity-software
2. https://www.coursera.org/projects/analyze-data-pivot-tables-crosstabs-google-sheets
3. https://www.coursera.org/learn/excel-advanced#syllabus
4. https://www.coursera.org/learn/how-to-create-a-website
5. https://support.microsoft.com/en-us/office
6. https://www.diagrams.net/
7. https://edu.google.com/

Course Outcomes:

1. Create / alter documents / Technical Paper / Project report with text, pictures, graphs ofdifferent styles.
2. Create / modify power point presentations with text, multimedia and to add animationusing / creating templates.
3. Perform basic calculations / retrieve data / createpivot tables / chart using a spreadsheetapplication.
4. Create simple diagrams / charts using online tools like: www.draw.io .
5. Manage documents, presentations, spreadsheets and websites in collaborative mode.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS12	PSO1	PSO2	PSO3
CO1					2				1	1					
CO2					2				1	1					
CO3	2	1	1		2				1	1					
CO4					2				1	1					
CO5					2				3	3					

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : September 6, 2021

ACADEMIC COUNCIL: 21st AC(September 17, 2021

SDG No. & Statement: 4 Quality Education

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

The students can perform simple document preparation to complex calculations in isolated mode and collaborative mode that are useful throughout their career.

<table>
<tr><td rowspan="2">CLAD1001</td><td rowspan="2">EMOTIONAL INTELLIGENCE & REASONING SKILLS (SOFT SKILLS 1)</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

Emotional intelligence is a set of skills that are thought to contribute to the appraisal of emotions in oneself and others. It can also help contribute to the effective regulation of emotions as well as feelings (Salovey & Mayer, 1990). In terms of emotional intelligence, self-awareness and self- management have to do with our ability to relate to ourselves. Social awareness and relationship management have to do with our ability to relate to others. Similarly, the ability to solve questions on Analytical Reasoning and Data Sufficiency is a critical area tested in almost all competitive examinations and admission tests. Upon completion, students should be able (1) to deal with theirown emotions as well as the emotions of others and relate better with both. Using better knowledgeof EI, students will also be able to set more meaningful goals for themselves, choose suitable time management techniques that work best for them and work in teams more effectively. (2) to apply different concepts, ideas, and methods to solve questions in reasoning and data sufficiency

Course Educational Objectives:

- Use EI to relate more effectively to themselves, their colleagues and to others. Apply self-awareness and self-assessment (SWOT) to better understand and manage their own emotions. Apply social awareness to empathize with others and build stronger relationships with others.
- Set meaningful goals based on their strengths and weaknesses and apply time management techniques, such as Q4 organizing to put first things first.
- Manage conflicts and work in teams in an emotionally intelligent manner.
- Solve questions on non-verbal and analytical reasoning, data sufficiency and puzzles

List of Activities & Tasks for Assessment:

Unit	Topics	Hours
1	Self-Awareness & Self-Regulation: Introduction to Emotional Intelligence, *Self-Awareness:* Self-Motivation, Accurate Self-Assessment (SWOT Analysis),Self-Regulation: *Self Control, Trustworthiness & Adaptability*	3
2	Importance, Practising Social Awareness, Building Relationships, Healthy andUnhealthy Relationships, Relationship Management Competencies- Influence, Empathy, Communication, Types of Conflicts, Causes, Conflict Management	3

3	Social Media: Creating a blog, use of messaging applications, creating awebsite to showcase individual talent, creation of a LinkedIn Profile	2
4	Goal Setting & Time Management: Setting SMART Goals, Time Wasters, Prioritization, Urgent Vs Important, Q2 Organization	3
5	Teamwork: Team Spirit, Difference Between Effective and Ineffective Teams, Characteristics of High Performance Teams, Team Bonding, Persuasion, Team Culture, Building Trust, Emotional Bank Account	4
6	Verbal Reasoning: Introduction, Coding-decoding, Blood relations, Ranking Directions, Group Reasoning	6
7	Analytical Reasoning: Cubes and Dices, Counting of Geometrical figures	3
8	Logical Deduction: Venn diagrams, Syllogisms, Data Sufficiency, Binary logic	4
9	Spatial Reasoning: Shapes, Paper Cutting/Folding, Mirror images, Water images and Rotation of figures	2

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, Career Launcher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Students will be able to relate more effectively to themselves, their colleagues and to others
2. Students will be able to set their short term and long term goals and better manage their time
3. Students will be able to manage conflicts in an emotionally intelligent manner and work inteams effectively
4. Students will be able to solve questions based on non-verbal and analytical reasoning, datasufficiency and puzzle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									3	3		2			
CO2	2	2	2	3	2	1	2		3	3		3			
CO3	2		2	3					3	2	2	2			
CO4	2	2	2	3		1					2	3			
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-201**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Emotional Intelligence and reasoning skills are essential for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

<table>
<tr><td rowspan="2">CLAD1011</td><td rowspan="2">LEADERSHIP SKILLS & QUANTITATIVE APTITUDE (SOFT SKILLS 2)</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

Communication Skills is having the ability to convey information to others so that messages are understood, and outcomes delivered. Some essential qualities of Communication Skills include understanding the needs of others, clearly communicating messages, adapting the communication style, and using a range of communication methods. Presentation Skills is having the ability to confidently deliver an engaging messageto a group of people which achieves the objectives. Some essential qualities of Presentation Skills include a thorough preparation of content, structuring content logically, managing nerves, engaging your audience, delivering presentation objectives, positively influencing the audience, and responding to audience needs.Tackling questions based on numbers, arithmetic, data interpretation and puzzles requires the application of different rules and concepts of numerical computation, numerical estimation, and data estimation.

Course Educational Objectives:

- Learn and apply, through different individual and group activities, different ideas, and skills tocommunicate in a positive and impressive manner.
- Apply the goal setting process (based on SWOT) and Q2 organizing for effective time management.
- Apply different concepts in numbers, numerical computation, and numerical estimation to solvequestions that often appear in various competitive examinations and admission tests.
- Apply different concepts for tackling questions based on data interpretation, progression and series thatare frequently given in various competitive examinations and admission tests.

List of Activities & Tasks for Assessment:

Unit	Topics	Hours
1	Communication Skills: The Communication Process, Elements of Interpersonal Communication, Non-Verbal Communication: Body Language, Posture, Eye Contact, Smile, Tone of Voice, Barriers to Communication. Effective Listening Skills: Active Listening, Passive	5

	Listening, Asking Questions, Empathizing, Being Non-Judgmental, Being Open Minded, Mass Communication: Design of Posters, Advertisements, notices, writing formal and informal invitations	
2	Focus on Audience Needs, focus on the Core Message, Use Body Language andVoice, Start Strongly, Organizing Ideas & Using Visual Aids: SPAM Model, EffectiveOpening and Closing Techniques, Guy Kawasaki's Rule (10-20-30 Rule), Overcoming Stage Fear, Story Telling	3
3	Problem Solving & Decision Making: Difference Between the Two, Steps in RationalApproach to Problem Solving: Defining the Problem, Identifying the Root Causes, Generating Alternative Solutions, Evaluating and Selecting Solutions, Implementingand Following-Up, Case Studies	3
4	Group Discussion: Understanding GD, Evaluation Criteria, Nine Essential Qualities for Success, Positive and Negative Roles, Mind Mapping, structuring a Response, Methods of Generating Fresh Ideas	4
5	Number Theory: Number System, Divisibility rules, Remainders and LCM & HCF	3
6	Numerical Computation and Estimation - I: Chain Rule, Ratio Proportions, Partnerships & Averages, Percentages, Profit-Loss & Discounts, Mixtures, Problem on Numbers & ages	6
7	Data Interpretation: Interpretation and analysis of data in Tables, Caselets, Line- graphs, Pie-graphs, Boxplots, Scatterplots and Data Sufficiency	3
8	Mental Ability: Series (Number, Letter and Alphanumeric), Analogy (Number, Letter and Alphanumeric) and Classifications	3

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, Career Launcher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Students will be able to communicate 'one-on-one' and 'one-on-many' confidently using both verbal and non-verbal messages and deliver impressive talks/ presentations to a group both with and without the use of PPTs and create posters, advertisements, etc.
2. Students will be able to apply the rational model of problem solving and decision makingin their problem solving and decision-making efforts.

3. Students will be able to solve questions based on numbers and arithmetic given in various competitive examinations
4. Students will be able to solve questions based on data interpretation, progressions, and series.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1						2			2	3		2			
CO2	2	2	3	2		3	3		3	3		2			
CO3	2	2	2	2		2						3			
CO4	2	2	2	2		2									
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Leadership and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

<table>
<tr><td rowspan="2">CLAD1021</td><td rowspan="2">VERBAL ABILITY & QUANTITATIVE ABILITY
(SOFT SKILLS 3)</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

Vocabulary is an important part of verbal ability. An understanding of word formation, prefixes, suffixes, and roots is necessary to remember and use a vast repository of words. Approaching words through word families and other ways of groupings is an effective way of gaining mastery over vocabulary. Understanding and getting acquainted with the different rules and exceptions in the use of grammar and structure, especially from the relevant examination point of view, is crucial to cracking questions given in many competitive tests. Similarly, improving reading comprehension skills and test taking abilities in this area takes time and effort, especially given the fact that most students do not possess strong reading habits. In so far as quantitative aptitude is concerned, students need to develop a strong foundation on the basic mathematical concepts of numerical estimation, geometry, mensuration, data sufficiency, etc. to be able to crack different round 1 tests of major recruiters and admission tests of top Indian and foreign universities.

Course Educational Objectives:

- List and discuss the different word formation methods, word denotation, connotation, collocation, etc. and introduce selected high frequency words, their antonyms, synonyms, etc.
- Apply different advanced reading skills to solve questions based on author's tone, main ideas and sub-ideas, inferences, Para jumbles, etc. that are frequently asked in various competitive exams and admission tests.
- Solve different types of questions based on vocabulary, such as word analogy; structure, grammar, and verbal reasoning; introduce common errors and their detection and correction.
- Solve questions on numerical estimation, mensuration, data sufficiency based on quantitative aptitude. This includes questions on time and work, time and distance, pipes and cisterns, lines and angles, triangles, quadrilaterals, polygons and circles, 2- & 3-dimensional mensuration.

List of Activities & Tasks for Assessment:

1. **Vocabulary Builder:** Understanding Word Formation, Prefixes, Suffixes and Roots, Etymology, Word Denotation, Connotation and Collocation, Synonyms and Antonyms

2. **Reading Comprehension:** Advanced Reading Comprehension: Types of RC passages, Types of Text Structures, Types of RC Questions: Distinguishing Between Major Ideas and Sub Ideas, Identifying the Tone and Purpose of the Author, Reading Between the Lines and Beyond the Lines, Techniques for Answering Different Types of Questions
3. **Para Jumbles:** Coherence and Cohesion, Idea Organization Styles, Concept of Mandatory Pairs and Its Application: Transitional Words, Antecedent-Pronoun Reference, Article Reference, Cause and Effect, Chronological Order, General to Specify, Specify to General, Idea-Example, Idea-Explanation, Etc.
4. **Grammar Usage:** Rules Governing the Usage of Nouns, Pronouns, Adjectives, Adverbs, Conjunctions, Prepositions and Articles
5. **Numerical Computation and Estimation - II:** Time and Work, Pipes and Cisterns, Time and Distance, Problems on Trains, Boats and Streams, Races and Games of Skill, Simple Interest& Compound Interest
6. **Geometry:** Lines and Angles, Triangles, Quadrilaterals & Polygons, and Circles
7. **Mensuration:** 2-Dimensional Mensuration (Triangles, Quadrilaterals and Circles), 3-Dimensional Mensuration (Cubes, Cuboids, Cylinder, Cone, Sphere)

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, Career Launcher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. List and discuss word formation methods, selected high frequency words, their antonyms, synonyms, etc.
2. Analyze reading passages and quickly find out the correct responses to questions asked, including para jumbles, by using reading skills like skimming, scanning, reading between the lines, etc.
3. Solve different types of questions based on vocabulary, structure, grammar and verbal reasoning
4. Solve questions on numerical estimation, mensuration, data sufficiency based on quantitative aptitude

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									1	3		2			
CO2				2		2				2		3			
CO3									1	2		3			
CO4	2	2	3			2						1			
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

CLAD1031	PRACTICING VERBAL ABILITY & QUANTITATIVE APTITUDE (SOFT SKILLS 4)	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

A sound knowledge of the rules of English grammar, structure and style and its application in detecting errors in writing are important areas of Verbal Ability frequently tested as a part of the written test in many competitive examinations and admission tests of major recruiters and universities respectively. This module focuses on all important areas of grammar and structure commonly asked in major tests, such as GMAT, CAT, XLRI, CRT, etc. Similarly, in the area of Quantitative Aptitude, different kinds of questions are asked from Combinatorics (Permutations & Combinations, Probability], Cryptarithmetic & Modular Arithmetic (Cryptarithmetic, Application of base system (7, 24), Clocks (Base 24), Calendars (Base 7), and Mental Ability (Number series, Letter series & Alpha numeric series, Analogies (Numbers, letters), Classifications, Algebra (Exponents, Logarithms, Problems related to Equations, Special Equations, and Statistics) . This module focuses on all these areas by building on what the students already learnt in their earlier studies.

Course Educational Objectives:

- Apply the rules of grammar to solve questions in Error Detection, Sentence Correction and Sentence Improvement.
- Apply the rules of structure to solve questions in Error Detection, Sentence Correction and Sentence Improvement, Fill-in-blanks and Cloze Passages.
- Explain methods of solving problems in Combinatorics (Permutations & Combinations, Probability], Cryptarithmetic & Modular Arithmetic (Cryptarithmetic, Application of basesystem (7, 24), Clocks (Base 24), Calendars (Base 7)]
- Explain how to solve questions in Mental Ability (Number series, Letter series & Alpha numeric series, Analogies, Numbers, letters, Classifications] and Algebra (Exponents, Logarithms, Problems related to Equations, Special Equations, Statistics)

List of Activities & Tasks for Assessment:

1. Error Detection: Pronouns, Conjunctions, Prepositions and Articles
2. Error Detection: Tenses and their Uses
3. Sentence Correction: Subject-Verb Agreement, Antecedent-Pronoun Agreement, Conditional Clauses
4. Sentence Correction: Modifiers (Misplaced and Dangling) & Determiners, Parallelism & WordOrder, and Degrees of Comparison
5. Combinatorics: Permutations & Combinations, Probability

6. Crypt arithmetic & Modular Arithmetic: Crypt arithmetic, Application of Base System (7, 24),Clocks (Base 24), Calendars (Base 7)
7. Algebra: Exponents, Logarithms, Word-problems related to equations, Special Equations,Progressions, Statistics

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, Career Launcher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Identify and correct errors in English grammar and sentence construction
2. Identify and correct errors in Structure, Style and Composition
3. Solve problems in Combinatorics, Cryptarithmetic, and Modular Arithmetic
4. Solve problems in Mental Ability and Algebra

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									1	3		1			
CO2									1	3		1			
CO3		2	3	2		2						2			
CO4		3	2	2		2						2			
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

CLAD2001	PREPARATION FOR CAMPUS PLACMENT -1 (SOFT SKILLS 5A)	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

The course addresses all relevant areas related to campus placements and readies them to ace their upcoming/ ongoing recruitment drives. Specifically, it focuses on students' career preparedness, interview skills, test preparedness, etc.

Course Educational Objectives:

Prepare the students for their upcoming/ ongoing campus recruitment drives.

List of Activities & Tasks for Assessment:

1. Career Preparedness: Resume & Cover Letter Writing, Interview Skills: Elevator Pitch, Making the First Impression, Being Other-Oriented, Being Positive and Curious, communicating with Confidence and Poise, Frequently Asked Questions & How to Answer Them, Pitfalls to Avoid, Etc. Etiquette: Hygiene, Courtesy, Culture differences, Workplace, use of cell phone, Profanity, Slang, Protocol.
2. Verbal Ability: Practicing Reading Comprehension, Error Detection, Sentence Completion, MCQs, FIBs, Para jumbles, Cloze Test, Critical Reasoning.
3. Quantitative Aptitude: Number Systems, Algebra, Geometry, Data Handling, Data Sufficiency, Word Problems
4. Reasoning: Logical and Verbal Reasoning

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and MeenakshiUpadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMSetc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Write a power resume and covering letter
2. Answer interview questions with confidence and poise
3. Exhibit appropriate social mannerisms in interviews
4. Solve placement test questions on verbal ability, quantitative aptitude and reasoning

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									3	2		1			
CO2						3			2			1			
CO3						2			1	3		3			
CO4		3		2		2			1			3			
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Quantitative aptitude, reasoning, verbal and language skills practiced during the preparation for campus placement tests provide essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

CLAD2011	PREPARATION FOR HIGHER EDUCATION (GRE/ GMAT)-1 (SOFT SKILLS 5B)	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

The course offers a special track for students who aspire to go abroad in pursuit of their higher education for which a GRE/ GMAT score is a prerequisite. It covers all four topical areas of these tests and includes fully solved mock tests as well.

Course Educational Objectives:

- Prepare the students to solve questions from all four broad areas of GRE/ GMAT
- Orient the students for GRE/ GMAT through mock tests

List of Activities & Tasks for Assessment:

1. Verbal Reasoning: Reading Comprehension, Sentence Equivalence, TextCompletion, Sentence Correction, Critical Reasoning
2. Quantitative Reasoning: Arithmetic, Algebra, Geometry, Data Analysis
3. Analytical Writing Assessment: Issue/ Argument
4. Integrated Reasoning

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and MeenakshiUpadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMSetc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Solve questions from all four broad areas of GRE/ GMAT
2. Practice answering several mock tests

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2	2	2					3			3			
CO2		2	2	2					3			3			
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Quantitative aptitude, reasoning, verbal and language skills practiced during the preparation for GRE/GMAT tests provide essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

<table>
<tr><td rowspan="2">CLAD2021</td><td rowspan="2">PREPARATION FOR CAT/ MAT – 1
(SOFT SKILLS 5C)</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

The course offers a special track for UG students who aspire to go for higher education in business management in India for which cracking CAT/ MAT/ other related test is mandatory. It covers all four topical areas of these tests and includes fully solved mock testsas well.

Course Educational Objectives:

- Prepare the students to solve questions from all four relevant areas of CAT/ XAT/MAT, etc.
- Orient the students for CAT/ XAT, etc. through mock tests

List of Activities & Tasks for Assessment:

1. Quantitative Ability: Arithmetic, Algebra, Geometry, Mensuration, Calculus, Trigonometry
2. Data Interpretation: Data Interpretation and Data Sufficiency
3. Logical Reasoning: Data Management, Deductions, Verbal Reasoning and Non-Verbal Reasoning
4. Verbal Ability: Critical Reasoning, Sentence Correction, Para Completion, Para Jumbles, Reading Comprehension

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, Career Launcher andIMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Solve questions from all four relevant areas of CAT/ MAT as listed above
2. Practice test-cracking techniques through relevant mock tests

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2		2			3	3	3	3			
CO2	2	2	2	2		1			2		2	3			
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Quantitative aptitude, reasoning, verbal and language skills practiced during the preparation for CAT/ MAT tests provide essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

<table>
<tr><td rowspan="2">CLAD2031</td><td rowspan="2">PREPARATION FOR CAMPUS PLACEMENT-2
(SOFT SKILLS 6A)</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course builds on the previous course and focuses on all four major areas of campus placements, including career preparedness, mock interviews, verbal ability, quantitative aptitude, and logical reasoning.

Course Educational Objectives:

- To comprehensively prepare all eligible and aspiring students for landing their dream jobs.
- To sharpen the test-taking skills in all four major areas of all campus drives

List of Activities & Tasks for Assessment:

1. Career Preparedness II: Mock Interviews, Feedback and Placement Readiness
2. Verbal Ability II: Practising Reading Comprehension, Error Detection, Sentence Completion, MCQs, FIBs, Para jumbles, Cloze Test, Critical Reasoning
3. Quantitative Aptitude II: Number Systems, Algebra, Geometry, Data Handling,Data Sufficiency, Word Problems
4. Reasoning II: Logical and Verbal Reasoning

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMSetc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Demonstrate career preparedness and confidence in tackling campus interviews
2. Solve placement test questions of a higher difficulty level in verbal ability, quantitative aptitude and logical reasoning.
3. Practice test-taking skills by solving relevant questions accurately and within time.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									2	3		2			
CO2	2	2	2	3		3			2	2	3	2			
CO3	2	2	2	3		2			1		2	3			
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Quantitative aptitude, reasoning, verbal and language skills practiced during the preparation for campus placement tests provide essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

CLAD2041	PREPARATION FOR HIGHER EDUCATION (GRE/GMAT)-2 (SOFT SKILLS 6B)	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

The course offers a special track for students who aspire to go abroad in pursuit of theirhigher education for which a GRE/ GMAT score is a prerequisite. It covers all four topical areas of these tests at a higher difficulty-level and includes fully solved mock tests as well.

Course Educational Objectives:

- Prepare the students to solve higher level questions from all four broad areas of GRE/ GMAT
- Orient the students for GRE/ GMAT through mock tests

List of Activities & Tasks for Assessment:

1. Verbal Reasoning II: Reading Comprehension, Sentence Equivalence, Text Completion, Sentence Correction, Critical Reasoning
2. Quantitative Reasoning II: Arithmetic, Algebra, Geometry, Data Analysis
3. Analytical Writing Assessment II: Issue/ Argument
4. Integrated Reasoning II

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and MeenakshiUpadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMSetc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Solve higher level questions from all four broad areas of GRE/ GMAT
2. Practice answering several mock tests

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2		3		2			2	2	2	2			
CO2		2		2		2			2	2	2	2			
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Quantitative aptitude, reasoning, verbal and language skills practiced during the preparation for GRE/GMAT tests provide essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

<table>
<tr><td rowspan="2">CLAD2051</td><td rowspan="2">PREPARATION FOR CAT/ MAT – 2
(SOFT SKILLS 6C)</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

The course offers a special track for UG students who aspire to go for higher education in business management in India for which cracking CAT/ MAT/ other related test is mandatory. It covers all four topical areas of these tests at a higher level of difficulty and includes fully solved mock tests as well.

Course Educational Objectives:

- Prepare the students to solve all types of questions from all four relevant areas of CAT/ XAT/ MAT, etc.

List of Activities & Tasks for Assessment:

1. Quantitative Ability II: Arithmetic, Algebra, Geometry, Mensuration, Calculus, Trigonometry
2. Data Interpretation II: Data Interpretation and Data Sufficiency
3. Logical Reasoning II: Data Management, Deductions, Verbal Reasoning and Non-Verbal Reasoning
4. Verbal Ability II: Critical Reasoning, Sentence Correction, Para Completion, Para Jumbles, Reading Comprehension

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and MeenakshiUpadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMSetc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Solve higher difficulty level questions from all four relevant areas of CAT/ MAT aslisted above
2. Practice test-cracking techniques through relevant mock tests

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3		3					3	3	3	2			
CO2	1	2		2					2	3	2	2			
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Quantitative aptitude, reasoning, verbal and language skills practiced during the preparation for CAT/ MAT tests provide essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

DOSL1001	CLUB ACTIVITY – PARTICIPANT	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course recognizes student participation in multiple activities organized by various student organizations that pursue specific co-curricular and extra-curricular interests. These activities allow students to engage in and identify and pursue their personal interests and hobbies.

Course Educational Objectives:

- Create opportunities for students to participate in a variety of non-academic experiences
- Interact with and learn from peers in a setting without an external performance pressure
- Allow exploration of interesting activities and reflection about these experiences
- Learn to manage time effectively

List of Student Club Activities:

1. Music (vocals, instruments, technical, recording, mixing, production, management)
2. Dance (Indian classical, western, jazz, latin, contemporary, folk, production, event management)
3. Theatre (classical, experimental, one-act, street, production, direction, casting, etc.)
4. Arts (fine arts, painting, calligraphy, sketching, caricaturing, etc)
5. Craft (origami, model making, sculpture, pottery, etc)
6. Cooking (home-style, baking, confectionery, Indian, intercontinental, etc.)
7. Graffiti (street, mural, collage, multi media, etc)
8. Workshops, quizzes, debates, elocution, etc
9. Filmmaking (adventure, drama, film appreciation, documentary, etc)
10. Photography (conventional, immersive (360), landscape, portrait, technical, editing, etc.)
11. College Fests
12. Designing (graphic design, landscape, interior, etc)
13. Competitive coding
14. Recreational sports activities
15. Other club activities organized by student clubs

List of Activities:

1. Participation in various club-based activities
2. Weekly reflection paper
3. Portfolio (on social media using an Instagram account)
4. Two learning papers (one per semester)

Textbooks:

1. Small move: big Change (Caroline Arnold)
2. How to Win at College: Surprising Secrets for Success from the Country's Top Students (Cal Newport)

References:

1. Making the most of college: Students speak their minds (author - Richard Light)
2. Failing Forward: Turning Mistakes into Stepping Stones for Success (John C Maxwell)
3. The Last Lecture (Randy Pausch)
4. Lean in (Sheryl Sandberg)
5. YouTube- Introduction to various club activities

Course Outcomes:

Upon successful completion of the course, student will be able to

1. Identify personal interest areas
2. Learn from diverse perspectives and experiences
3. Gain exposure to various activities and opportunities for extra-curicular activities
4. Learn to manage time effectively
5. gain confidence

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1								3	3	2	3	2			
CO2									3	3		2			
CO3									3	3	2	3			
CO4									3	3		3			
CO5								3	3	3		2			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

This course recognizes student participation in non-academic events and activities which focus on inclusive partnerships and collaborations with all stakeholders by using all sustainable means to promote lifelong learning.

DOSL1011	CLUB ACTIVITY – MEMBER OF THE CLUB	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course encourages and acknowledges student members' work in organizing events and activities organized by various student organizations that pursue specific co-curricular and extra- curricular interests. These activities allow students to actively learn from the process of conceptualizing and organizing such activities as part of a team.

Course Educational Objectives:

- Create opportunities for students to learn from organizing club activities
- Learn teamwork, leadership, planning and management of events and activities
- Learn to appreciate multiple perspectives, cultures, and individual capabilities
- Learn to manage time effectively

List of Student Club Activities:

1. Music (vocals, instruments, technical, recording, mixing, production, management)
2. Dance (Indian classical, western, jazz, latin, contemporary, folk, production, event management)
3. Theatre (classical, experimental, one-act, street, production, direction, casting, etc.)
4. Arts (fine arts, painting, calligraphy, sketching, caricaturing, etc)
5. Craft (origami, model making, sculpture, pottery, etc)
6. Cooking (home-style, baking, confectionery, Indian, intercontinental, etc.)
7. Graffiti (street, mural, collage, multi media, etc)
8. Workshops, quizzes, debates, elocution, etc
9. Filmmaking (adventure, drama, film appreciation, documentary, etc)
10. Photography (conventional, immersive (360), landscape, portrait, technical, editing, etc.)
11. College Fests
12. Designing (graphic design, landscape, interior, etc)
13. Competitive coding
14. Recreational sports activities
15. Other club activities organized by student clubs

List of Activities:

1. Be a member of a club and organize activities in that particular interest area
2. Learn from diverse perspectives and experiences
3. Learn to design and execute extra-curricular activities
4. Develop management skills through hands on experience
5. Explore different managerial roles and develop competencies

Textbooks:

1. Small move: big Change (Caroline Arnold)
2. How to Win at College: Surprising Secrets for Success from the Country's Top Students (Cal Newport)

References:

1. Making the most of college: Students speak their minds (author - Richard Light)
2. Failing Forward: Turning Mistakes into Stepping Stones for Success (John C Maxwell)
3. The Last Lecture (Randy Pausch)
4. Lean in (Sheryl Sandberg)
5. Youtube- Introduction to various club activities

Course Outcomes:

Upon successful completion of the course, student will be able to

- Be a member of a club and organize activities in that particular interest area
- Learn from diverse perspectives and experiences
- Learn to design and execute extra-curricular activities
- Develop management skills through hands on experience
- Explore different managerial roles and develop competencies

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1								3	3	3		3			
CO2									3	2		3			
CO3								3	3	2					
CO4										2	3	3			
CO5								2				3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:

SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

SDG17 : Strengthen the means of implementation and revitalize the global partnership for sustainable development

SDG Justification:

This course recognizes student participation in community service endeavours focussing on sustainable development, service to communities. This allows students to develop empathy, citizenship behaviour and inclusive community values.

DOSL1021	CLUB ACTIVITY – LEADER OF THE CLUB	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course encourages and recognizes student members' work in leading the student organizationsthrough various leadership roles. As leaders they work not just to organize events and activities in specific co-curricular and extra-curricular interests, but also lead the teams that form the core members of the clubs. These activities allow students to learn and practice leadership and management skills through real world experience.

Course Educational Objectives:

- Create opportunities for students to learn from organizing club activities
- Learn teamwork, leadership, planning and management of events and activities
- Learn to appreciate multiple perspectives, cultures, and individual capabilities
- Learn to manage time effectively

List of Student Club Activities:

1. Music (vocals, instruments, technical, recording, mixing, production, management)
2. Dance (Indian classical, western, jazz, latin, contemporary, folk, production, event management)
3. Theatre (classical, experimental, one-act, street, production, direction, casting, etc.)
4. Arts (fine arts, painting, calligraphy, sketching, caricaturing, etc)
5. Craft (origami, model making, sculpture, pottery, etc)
6. Cooking (home-style, baking, confectionery, Indian, intercontinental, etc.)
7. Graffiti (street, mural, collage, multimedia, etc)
8. Workshops, quizzes, debates, elocution, etc
9. Filmmaking (adventure, drama, film appreciation, documentary, etc)
10. Photography (conventional, immersive (360), landscape, portrait, technical, editing, etc.)
11. College Fests
12. Designing (graphic design, landscape, interior, etc)
13. Competitive coding
14. Recreational sports activities
15. Other club activities organized by student clubs

List of Activities:

1. Be the leader of the club and implement the charter, vision and mission of the club
2. Learn from diverse perspectives and experiences
3. Learn to lead the team, design and execute extra-curricular activities
4. Develop management skills through hands on experience
5. Explore different managerial roles and develop competencies

Textbooks:

1. Small move: big Change (Caroline Arnold)
2. How to Win at College: Surprising Secrets for Success from the Country's Top Students(Cal Newport)

References:

1. Making the most of college: Students speak their minds (author - Richard Light)
2. Failing Forward: Turning Mistakes into Stepping Stones for Success (John C Maxwell)
3. The Last Lecture (Randy Pausch)
4. Lean in (Sheryl Sandberg)
5. Youtube- Introduction to various club activities

Course Outcomes:

Upon successful completion of the course, student will be able to

- Be the leader of the club and implement the charter, vision and mission of the club
- Learn from diverse perspectives and experiences
- Learn to lead the team, design and execute extra-curricular activities
- Develop management skills through hands on experience
- Explore different managerial roles and develop competencies

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1								3	3	3		3			
CO2									3	2		3			
CO3								3	3	2					
CO4										2	3	3			
CO5								2				3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:

SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

SDG17 : Strengthen the means of implementation and revitalize the global partnership for sustainable development

SDG Justification:

This course recognizes student participation in community service endeavours focussing on sustainable development, service to communities. This allows students to develop empathy, citizenship behaviour and inclusive community values.

DOSL1031	CLUB ACTIVITY – COMPETITOR	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course encourages and recognizes student members' work in leading the student organizationsthrough various leadership roles. As leaders they work not just to organize events and activities in specific co-curricular and extra-curricular interests, but also lead the teams that form the core members of the clubs. These activities allow students to learn and practice leadership and management skills through real world experience.

Course Educational Objectives:

- Create opportunities for students to learn from organizing club activities
- Learn teamwork, leadership, planning and management of events and activities
- Learn to appreciate multiple perspectives, cultures, and individual capabilities
- Learn to manage time effectively

List of Student Club Activities:

1. Music (vocals, instruments, technical, recording, mixing, production, management)
2. Dance (Indian classical, western, jazz, latin, contemporary, folk, production, event management)
3. Theatre (classical, experimental, one-act, street, production, direction, casting, etc.)
4. Arts (fine arts, painting, calligraphy, sketching, caricaturing, etc)
5. Craft (origami, model making, sculpture, pottery, etc)
6. Cooking (home-style, baking, confectionery, Indian, intercontinental, etc.)
7. Graffiti (street, mural, collage, multimedia, etc)
8. Workshops, quizzes, debates, elocution, etc
9. Filmmaking (adventure, drama, film appreciation, documentary, etc)
10. Photography (conventional, immersive (360), landscape, portrait, technical, editing, etc.)
11. College Fests
12. Designing (graphic design, landscape, interior, etc)
13. Competitive coding
14. Recreational sports activities
15. Other club activities organized by student clubs

List of Activities:

1. Be the leader of the club and implement the charter, vision and mission of the club
2. Learn from diverse perspectives and experiences
3. Learn to lead the team, design and execute extra-curicular activities
4. Develop management skills through hands on experience
5. Explore different managerial roles and develop competencies

Textbooks:

1. Small move: big Change (Caroline Arnold)
2. How to Win at College: Surprising Secrets for Success from the Country's Top Students (Cal Newport)

References:

1. Making the most of college: Students speak their minds (author - Richard Light)
2. Failing Forward: Turning Mistakes into Stepping Stones for Success (John C Maxwell)
3. The Last Lecture (Randy Pausch)
4. Lean in (Sheryl Sandberg)
5. Youtube- Introduction to various club activities

Course Outcomes:

Upon successful completion of the course, student will be able to

1. Be the leader of the club and implement the charter, vision and mission of the club
2. Learn from diverse perspectives and experiences
3. Learn to lead the team, design and execute extra-curricular activities
4. Develop management skills through hands on experience
5. Explore different managerial roles and develop competencies

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1								3	3	3		3			
CO2									3	2		3			
CO3								3	3	2					
CO4										2	3	3			
CO5								2				3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:

SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

SDG17 : Strengthen the means of implementation and revitalize the global partnership for sustainable development

SDG Justification:

This course recognizes student participation in community service endeavours focussing on sustainable development, service to communities. This allows students to develop empathy, citizenship behaviour and inclusive community values.

DOSL1041	COMMUNITY SERVICES - VOLUNTEER	L	T	P	S	J	C
		0	0	0	0	2	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course recognizes student participation in Community service activities organized by various student organizations and other Government and non-government organizations that exist for providing service to communities. These activities allow students to develop empathy, citizenship behavior and community values.

Course Educational Objectives:

- To help students develop empathy and citizenship behavior
- Enable students to develop an altruistic attitude and community development sensibility
- Allow exploration of community service activities and reflect about these experiences
- Learn to work in small and large teams for achieving community objectives

List of Community Service Activities:

1. Community Health Services
2. Swachh Bharat Abhiyan and other Cleanliness drives
3. Tree Plantation and similar environmental conservation initiatives
4. Rain water harvesting awareness and implementation
5. Fundraising and visits to Orphanages, Old-age homes, etc.
6. Health and disease awareness programs
7. Working with NGOs
8. Disaster mitigation and management training and relief work
9. Rural Upliftment projects
10. Campus awareness and action projects (cleanliness, anti-ragging, blood donation, etc)
11. Community investigations and surveys for development research
12. Educational support for underprivileged (remedial classes, coaching, training, etc)
13. Service camps
14. Advocacy and information literacy initiatives
15. Other activities serving local communities

List of Activities:

1. Participation in various community service activities
2. Weekly reflection paper
3. Portfolio (on social media using an instagram account)
4. Two learning papers (one per semester)

Text Books:

1. Soul of a citizen: living with conviction in Challenging times (author: Paul Rogat Loeb)
2. Community Services intervention: Vera Lloyd

References:

1. A path appears: Transforming lives, creating opportunities (Nicholas Kristof and SherylWuDunn)
2. The story of My Experiments with Truth (author: M. K. Gandhi)

Course Outcomes:

1. Experience of volunteering in a variety of Community service activities
2. Gaining empathy for lesser privileged sections of society by experience
3. Understanding the process of generating community awareness
4. Understanding Disaster management and relief through training and experience
5. Developing environmental and sustainability awareness

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1								3	3	3		3			
CO2									3	2		3			
CO3								3	3	2					
CO4										2	3	3			
CO5								2				3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:

SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

SDG17 : Strengthen the means of implementation and revitalize the global partnership for sustainable development

SDG Justification:

This course recognizes student participation in community service endeavours focussing on sustainable development, service to communities. This allows students to develop empathy, citizenship behaviour and inclusive community values.

DOSL1051	COMMUNITY SERVICES - MOBILIZER	L	T	P	S	J	C
		0	0	0	0	2	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course recognizes student leadership in mobilizing community service activities as members of various student organizations or other Government and non-government organizations that existfor providing service to communities. These activities allow students to develop leadership, management skills, empathy, citizenship behavior and community values.

Course Educational Objectives:

- To help students understand leadership in a community environment
- Enable students to develop an altruistic attitude and community development sensibility
- Allow deep understanding of community service through practical experience
- Learn to lead small and large teams for achieving community objectives

List of Community Service Activities:

1. Community Health Services
2. Swachh Bharat Abhiyan and other Cleanliness drives
3. Tree Plantation and similar environmental conservation initiatives
4. Rain water harvesting awareness and implementation
5. Fundraising and visits to Orphanages, Old-age homes, etc.
6. Health and disease awareness programs
7. Working with NGOs
8. Disaster mitigation and management training and relief work
9. Rural Upliftment projects
10. Campus awareness and action projects (cleanliness, anti-ragging, blood donation, etc)
11. Community investigations and surveys for development research
12. Educational support for underprivileged (remedial classes, coaching, training, etc)
13. Service camps
14. Advocacy and information literacy initiatives
15. Other activities serving local communities

List of Activities:

1. Organizing and leading teams in various community service activities
2. Fortnightly reflection paper

3. Portfolio (on social media using an instagram account)
4. Two learning papers (one per semester)

Textbooks:

1. Soul of a citizen: living with conviction in Challenging times (author: Paul Rogat Loeb)
2. Community Services intervention: Vera Lloyd

References:

1. A path appears: Transforming lives, creating opportunities (Nicholas Kristof and SherylWuDunn)
2. The story of My Experiments with Truth (author: M. K. Gandhi)
3. List of student run and other Government and non- government community service organizations

Course Outcomes:

1. Experience of mobilizing and executing Community service activities
2. Providing opportunities for community service volunteering for other fellowstudents
3. Understanding the process of mobilizing cash, kind and volunteer support
4. Building leadership and management skills
5. Building empathy and citizenship behavior

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1								3	3	3		3			
CO2									3	2		3			
CO3								3	3	2					
CO4										2	3	3			
CO5								2				3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:

SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

SDG17 : Strengthen the means of implementation and revitalize the global partnership for sustainable development

SDG Justification:

This course recognizes student participation in community service endeavours focussing on sustainable development, service to communities. This allows students to develop empathy, citizenship behaviour and inclusive community values.

DOSP1001	BADMINTON	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Badminton - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Badminton: Grips - Racket, shuttle
4. Sports Specific fitness and warmup drills
5. Stances and footwork
6. Badminton Gameplay: Service, Forehand, Backhand
7. Preparatory Drills and Fun Games
8. Game Variations: Singles/ Doubles/ Mixed

References:

1. Handbook of the Badminton World Federation (BWF)

Course Outcomes:

1. Learn to play Badminton
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									3	2		3			
CO2												2			
CO3												2			
CO4							2		3	3	2				
CO5						2	2		3			3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1011	CHESS	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Chess - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Chess: Pieces & functions, basic play
4. Chess board moves & terminology
5. Chess Gameplay: Openings, castling, strategies & tactics
6. Preparatory Drills and Fun Games
7. Game Variations & Officiating

References:

1. International Chess Federation (FIDE) Handbook

Course Outcomes:

1. Learn to play Chess
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									3	2		3			
CO2												2			
CO3												2			
CO4							2		3	3	2				
CO5						2	2		3			3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

<table>
<tr><td rowspan="2">DOSP1021</td><td rowspan="2">CARROM</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>2</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Carrom - History and development
2. Rules of the Game, Board components & dimensions
3. Fundamental Skills - Carrom: - Striking
4. Gameplay – General
5. Preparatory Drills and Fun Games
6. Game Variations: Singles/ Doubles/ Mixed
7. Preparatory Drills and Fun Games

References:

1. Indian Carrom Federation Handbook - Laws

Course Outcomes:

1. Learn to play Carrom

2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									3	2		3			
CO2												2			
CO3												2			
CO4							2		3	3	2				
CO5						2	2		3			3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1031	FOOTBALL	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Football - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Kicking, heading, ball control, Keeping
4. Movement, throwins, tackling, defense, scoring, defense
5. Gameplay- Formations, passing, FKs, CKs, PK, tactics
6. Preparatory Drills and Fun Games
7. Game Variations: Small sided games, 7v7, 11v11

References:

1. FIFA Laws of the Game

Course Outcomes:

1. Learn to play Football
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									3	2		3			
CO2												2			
CO3												2			
CO4							2		3	3	2				
CO5						2	2		3			3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1041	VOLLEYBALL	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Volley - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Striking, Ball control, Lifting
4. Sports Specific fitness and warmup drills
5. Stances and footwork
6. Preparatory Drills and Fun Games
7. Gameplay: Jumps, strikes, layoffs, attack, defense

References:

1. FIVB - Official Volleyball Rules

Course Outcomes:

1. Learn to play Volleyball
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									3	2		3			
CO2												2			
CO3												2			
CO4							2		3	3	2				
CO5						2	2		3			3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1051	KABADDI	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Kabaddi - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Raiding, catching
4. Sports Specific fitness and warmup drills
5. Stances and footwork
6. Preparatory Drills and Fun Games
7. Gameplay: Chain system movement

References:

1. Amateur Kabaddi Federation of India (AKFI) - Official Rules

2. Rules of Kabaddi - International Kabaddi Federation

Course Outcomes:

1. Learn to play Kabaddi
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1									3	2		3				
CO2												2				
CO3												2				
CO4							2		3	3	2					
CO5						2	2		3			3				

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1061	KHO KHO	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Kho Kho - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills: Sitting, giving Kho, Pole dive
4. Sports Specific fitness and warmup drills
5. Stances and footwork: Running, sitting
6. Gameplay: Running strategies, ring method, chain method
7. Preparatory Drills and Fun Games

References:

1. Khelo India Official Rulebook of Kho Kho

Course Outcomes:

1. Learn to play Kho Kho
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1									3	2		3				
CO2												2				
CO3												2				
CO4							2		3	3	2					
CO5						2	2		3			3				

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1071	TABLE TENNIS	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Table Tennis - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - TT: Grips - Racket, ball
4. Stances and footwork
5. TT Gameplay- Forehand, Backhand, Side Spin, High Toss. Strokes-Push, Chop, Drive, Half Volley, Smash, Drop-shot, Balloon, Flick, Loop Drive.
6. Preparatory Drills and Fun Games
7. Game Variations: Singles/ Doubles/ Mixed

References:

1. Handbook of the International Table Tennis Federation (ITTF)

Course Outcomes:

1. Learn to play Table Tennis
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1									3	2		3				
CO2												2				
CO3												2				
CO4							2		3	3	2					
CO5						2	2		3			3				

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1081	HANDBALL	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Handball - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Handball: Throwing, Ball control, Movement
4. Sports Specific fitness and warmup drills
5. Stances and footwork: Jumps, dribbles, catching, throws
6. Gameplay: Shots, throws, movements, attack, defense
7. Preparatory Drills and Fun Games

References:

1. International Handball Federation - Rules of the Game & Regulations

Course Outcomes:

1. Learn to play Handball
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1									3	2		3				
CO2												2				
CO3												2				
CO4							2		3	3	2					
CO5						2	2		3			3				

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1091	BASKETBALL	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Basketball - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Passing, Receiving, Dribbling
4. Sports Specific fitness and warmup drills
5. Stances and footwork: Jumps, dribbles, catching, throws
6. Preparatory Drills and Fun Games
7. Gameplay: Shots, throws, movements, attack, defense

References:

1. FIBA Basketball Official Rules

Course Outcomes:

1. Learn to play Basketball
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1									3	2		3				
CO2												2				
CO3												2				
CO4							2		3	3	2					
CO5						2	2		3			3				

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1101	TENNIS	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Tennis - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Tennis: Grips - Racket, ball
4. Stances and footwork
5. Gameplay- Forehand, Backhand, Service, volley, smash
6. Preparatory Drills and Fun Games
7. Game Variations: Singles/ Doubles/ Mixed

References:

1. Handbook of the International Tennis Federation (ITF)

Course Outcomes:

1. Learn to play Tennis
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1									3	2		3				
CO2												2				
CO3												2				
CO4							2		3	3	2					
CO5						2	2		3			3				

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

<table>
<tr><td rowspan="2">DOSP1111</td><td rowspan="2">THROWBALL</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>2</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Throwball - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Throwing, Receiving
4. Sports Specific fitness and warmup drills
5. Stances and footwork
6. Preparatory Drills and Fun Games
7. Gameplay: Shots, throws, movements, control

References:

1. World Throwball Federation - Rules of the Game

Course Outcomes:

1. Learn to play Throwball
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									3	2		3			
CO2												2			
CO3												2			
CO4							2		3	3	2				
CO5						2	2		3			3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

ENVS1001	ENVIRONMENTAL STUDIES	L	T	P	S	J	C
		3	0	0	0	0	3*
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

The course enables the students to adapt eco-centric thinking and actions rather than human-centric thinking on natural resources, their utilization and conservation. The course also focuses on the importance of ecosystems, biodiversity and their degradation led to pollution. This course helps in finding solutions through application of control measures to combat pollution and legal measures to achieve sustainable development.

Course Educational Objectives:

- To impart knowledge on natural resources and its associated problems.
- To familiarize learners about ecosystem, biodiversity, and their conservation.
- To introduce learners about environment pollution.
- To acquaint learners on different social issues such as conservation of water, green buildingconcept.
- To make learners understand about the present population scenario, its impacts and role ofinformational technology on environment and human health.
- To make learners understand about the importance of field visit.

UNIT 1 **Multidisciplinary nature of environmental studies & Natural Resources** **10 hours**

Multidisciplinary nature of environmental studies Definition, scope and importance. Need for public awareness. Natural resources and associated problems. Uses and over exploitation of Forest resources, Water resources, Mineral resources, Food resources, Energy resources. Role of an individual in conservation of natural resources.

Activity:

1. Planting tree saplings
2. Identification of water leakage in house and institute-Rectify or report
3. Observing any one day of a week as Car/bike/vehicle free day.

UNIT 2 Ecosystem and biodiversity 10 hours

Ecosystem: Structure components of ecosystem: Biotic and Abiotic components. Functional components of an ecosystem: Food chains, Food webs, Ecological pyramids, Energy flow in the ecosystem (10% law), Ecological succession.

Biodiversity: Definition, Biogeographical classification of India, Values of biodiversity: consumptive use, productive use, social, ethical, aesthetic. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching, man wildlife conflicts. Conservation of biodiversity: In – situ and Ex-situ

Activity:

1. Visit to Zoological Park-Noting different ecosystem
2. Biodiversity register- Flora and fauna in the campus

UNIT 3 Environmental Pollution 10 hours

Definition Causes, effects, and control measures of: -Air pollution. Water pollution. Soil pollution. Marine pollution. Noise pollution. Nuclear hazards. Solid waste Management: Causes, effects, and control measures. Role of an individual in prevention of pollution. Pollution case studies.

Activity:

1. Visit to treatment plant and documentation.
2. Documentation of segregation of solid waste-Dry and Wet

UNIT 4 Social Issues and the Environment 10 hours

From Unsustainable to Sustainable development Urban problems related to energy. Water conservation, rainwater harvesting, watershed management. Environmental ethics: Issues and possible solutions. Green building concept.

Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies.

Activity:

1. Observing zero hour at individual level-documentation.
2. Eco friendly idols.
3. Rainwater harvesting-creating storage pits in nearby area.

UNIT 5 **Human Population and the Environment and Environment Protection Act and Field work** **10 hours**

Population growth, variation among nations. Environment and human health. HIV/AIDS, Human rights. Value Education. Women and Child Welfare. Role of Information Technology in Environment and human health. Environment Legislation. Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act. Wildlife Protection Act. Environmental Protection Act, Issues involved in enforcement of environmental legislation.

Activity:

1. Visit to a local polluted site-industry/agriculture
2. Identifying diseases due to inappropriate environmental conditions

Text Book(s):

1. Erach Bharucha. Textbook of environmental studies for undergraduates courses-Universities Press,India Private Limited. 2019.
2. Kaushik A and Kaushik C.P. Perspectives in Environmental Studies. New Age InternationalPublishers Edition-VI. 2018.
3. Dave D Katewa S.S. Textbook of Environmental Studies, 2nd Edition. Cengage Learning India. 2012.

Additional Reading:

1. Benny Joseph. Textbook of Environmental Studies 3rd edition, McGraw Hill Publishing company limited. 2017.

Reference Book(s):

1. McKinney M.L., Schoch R.M., Yonavjak L. Mincy G. Environmental Science: Systems andSolutions. Jones and Bartlett Publishers. 6th Edition. 2017.
2. Botkin D.B. Environmental Science: Earth as a Living Planet. John Wiley and Sons. 5th edition. 2005.

Journal(s):

1. https://www.tandfonline.com/loi/genv20
2. https://library.lclark.edu/envs/corejournals

Website(s):

https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf From Climate Science to Action | Coursera

Course Outcomes:

After the completion of the course student will be able to

1. List different natural resources and their uses
2. Summarize the structure and function of terrestrial and aquatic ecosystems.
3. Identify causes, effects, and control measures of pollution (air, water & soil).

4. Function of green building concept.
5. Adapt value education

CO-PO Mapping:

	Programme Objectives (POs)												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2												2		
CO2		2				1							2		
CO3			1						1					1	
CO4				2							2				1
CO5	1													1	
CO6					2							1			1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN: BOS

BOS: 04-07-22 **ACADEMIC COUNCIL:14-07-22**

SDG No. & Statement:

1. SDG-6-Clean water and Sanitation
2. SDG-7-Affordable and clean energy
3. SDG-13 - Climate change
4. SDG-14 - Life below water
5. SDG-15 - Life on Land

SDG Justification:

1. The learner will understand the importance of clean water and sanitation through this course and apply in their daily activities – SDG-6

2. The learner will make use of renewable resources to reduce pollution achieves SDG-7

3. The learner will understand present situation in climate change and takes appropriate steps to combat climate change – SDG-13

4. The learner will understand the existence of life below water – SDG-14

5. The learner will understand to promote sustainable terrestrial ecosystem – SDG15

FINA3001	PERSONAL FINANCIAL PLANNING	L	T	P	S	J	C
		0	0	2	0	0	1*
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	Risk Management in Personal financing Fundamentals of Investing Saving Money for the future Personal and Family Financial Planning Introduction to Personal Finance						

Course Description:

Personal Financial Planning is one of the most significant factors in our lives. It is essential that funds are available as and when required at various stages of life. Unavailability of funds at critical stages of our life leads to financial distress and leads to many medical and non- medical problems. There are certain planned and unplanned events in our life. On the one hand,education of our children, their marriage, our retirement etc. are some of the planned events ofour life, but at the same time, some medical urgency, accident or death of an earning member might be some unplanned events. Many of these events are beyond our control, but the availability of funds can be planned to avoid any financial distress. In other words, we cannot stop the rain but can plan for an umbrella.
This course looks at the many challenges an individual faces in a complex financial environment and the rising uncertainties of one's life. It focuses on achieving long-term financial comfort of individual and family through goal setting, developing financial and life strategies, acquiring personal financial planning knowledge and managing risk throughout one's life.

Course Educational Objectives:

- To build students' ability to plan for long-term financial comfort of individual andfamily through goal setting, developing financial and life strategies.
- To provide students with knowledge on terms, techniques to evaluate investment avenues.
- To build the skill set of the student to enable them to file their tax returns.

UNIT 1 Basics of Financial Planning

Financial Planning Meaning, Need, Objectives, Financial Planning Process, Time Value of Money and its application using excel (NP)

UNIT 2 Risk and Insurance Management

Need for insurance, Requirement of insurance interest, Role of insurance in personal finance, Steps in insurance planning, Life and Non-life insurance products, Life insurance needs analysis (NP)

UNIT 3 Investment Products and Measuring Investment Returns

Investment Products: Small Saving Instruments, Fixed Income Instruments, Alternate Investments, Direct Equity
Measuring Investment Returns: Understanding Return and its concept, Compounding concept, Real vs Nominal Rate of Return, Tax Adjusted Return, Risk-Adjusted Return (NP)

UNIT 4 Retirement Planning

Introduction to the retirement planning process, estimating retirement corpus, Determining the retirement corpus, Retirement Products (NP)

UNIT 5 Tax Planning

Income Tax: Income tax principles: Heads of Incomes, Exemptions and Deductions, Types of Assesses, Rates of Taxation, Obligations for Filing and Reporting, Tax aspects of Investment Products, Wealth Tax

Textbooks:

1. National Institute of Securities Management (NISM) Module 1 & XA
2. Madhu Sinha, Financial Planning, 2 Edition, McGraw Hill India
3. Simplified Financial Management by Vinay Bhagwat, The Times Group

References:

1. Personal Financial Planning (Wealth Management) by S Murali and K R Subbakrishna, Himalaya Publishing House.
2. Mishra K.C., Doss S, (2009). Basics of Personal Financial Planning 1e. NationalInsurance Academy, New Delhi: Cengage Learning.
3. Risk Analysis, Insurance and Retirement Planning by Indian Institute of Banking andFinance.

Course Outcomes:

1. Describe the financial planning process and application of time value of money
2. Application of life and non-life insurance products in financial planning
3. Understand the investment avenues and analysis of investment returns
4. Understand the retirement planning and its application
5. Describe and analysis the Tax Planning

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	0	0	1	0	0	1	1	1	0	3	1	1	3
CO2	2	2	0	0	1	1	1	1	0	1	1	3	1	1	2
CO3	3	2	1	0	1	0	0	1	0	1	1	3	2	2	3
CO4	3	2	0	1	1	0	1	1	0	1	1	2	2	3	2
CO5	3	3	0	1	1	1	2	1	0	1	1	1	2	2	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 01-02-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

Goal 4: Quality education

Goal 12: Responsible consumption and Production

SDG Justification:

Goal 4: This course enables the students to attain their financial literacy that builds in the discipline of saving and improves their lifelong learnings.

Goal 12: This course ensures sustainable consumption and helps in providing them their life long financial requirements .

<table>
<tr><td rowspan="2">LANG1012</td><td rowspan="2">COMMUNICATION SKILLS IN ENGLISH – INTERMEDIATE</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description

Communication Skills in English (Intermediate) is the second of the three-level graded courses for the developmental enhancement of communication skills in English. Based on the learning outcomes set in the beginner-level syllabus, this course focuses on giving learners more exposure to the use of language for communicative purposes and equipping them with next level skills (ref. Bloom's taxonomy) and practice in complexity and cognitive engagement. This course also includes the inferential level of comprehension (listening and reading) that involves analysis and application of language skills and decision-making skills while speaking/writing with an awareness of social and personality-based communication variations. This course emphasizesguided writing through adequate pre- and post-context building tasks. The focus is on the stimulation and application of critical thinking in addition to schematic review for communication in real-life situations.

Course Educational Objectives

- Train learners to listen to short audio texts with familiar content actively; guided activity like question-making and responding to others' questions based on the audio text would help learners engage in transactional dialogue; extended activities like extrapolating/critiquing the responses would help learners enhance their schematic thinking. (Bloom's Taxonomy Level/s: 2 & 4)
- Equip learners with strategies to read actively and critically and understand the writers' viewpoints and attitude by providing reading comprehension tasks using authentic texts such as op-ed articles from newspapers, and reports on contemporary problems. (Bloom'sTaxonomy Level/s: 4 & 5)
- Help learners understand various aspects and techniques of effective presentations (group/individual) through demonstration and modelling, enabling them to develop their presentation skills by providing training in using the tips and strategies. Learners would be encouraged to observe and express opinion on teacher-modelling. Reflection on issues like anxiety, stage-fear, confidence, and levels of familiarity with topic and audience would be addressed. Practice would be given on tone, pitch, clarity and other speech aspects. Detailed peer feedback and instructor's feedback would cover all the significant aspects. (Bloom's Taxonomy Level/s: 2 & 4)
- Enable learners to become aware of the structure and conventions of academic writing through reading, demonstration, scaffolding activities, and

discussion. Corrective individual feedback would be given to the learners on their writing. (Bloom's Taxonomy Level/s: 2 & 3)

List of Tasks and Activities

S. No.	Tasks	Activities
1	Listening to subject related short discussions/explanations/ speech for comprehension	Pre-reading group discussion, Silent reading (Note-making), Modelling (questioning), Post-reading reflection /Presentation
2	Asking for information: asking questions related tothe content, context maintaining modalities	Group role-play in a context (i.e. Identifying the situation and different roles and enacting theirroles)
3	Information transfer: Visual to verbal (unfamiliarcontext); demonstration by teacher, learners' task(guided with scaffolding), learners' task (free), presentation and feedback	Pre-reading game/modelling, discussion in smallgroups, individual writing, and feedback
4	Introducing officials to peers and vice versa - Formal context	AV support, noticing, individual performance (3-4), pair work (in context), teacher modelling, group work for Introducing self and others in a formal context
5	Vocabulary in context: Find clues in a text and usethem to guess the meaning of words/phrases. Apply the newly learnt vocabulary in communication (speaking and writing).	Comprehending verbal communication: Identifying the contextual clues in oral and written texts; guessing the meaning of words/phrases in context while reading texts andlistening to discussions/talks
6	Follow the essentials of lectures, talks, discussions, reports and other forms of academicpresentations and mark individual and group presentations aided with images, audio, video, tabular data, etc.	Making power point presentation aided with images, audio, video, etc. with a small group bylistening to academic lectures/talks/ discussions,etc.
7	Collaborative work (speaking and writing) in small groups of 3 or 4 learners: discussing a general/discipline-specific topic: creating outline,assigning specific roles to members of the group;and group presentation followed by peer and instructor feedback	Pre-task modelling (peer/teacher), general discussion on structure, group work (collaboration), feedback
8	Independent reading of different text types using appropriate reference sources by adapting suitable reading styles and speed. Focus on active reading for vocabulary: low-frequency collocations and idiomatic expressions.	Brain-storming, mapping of key terms (content specific), reading and note-making (individual),oral questioning, discussion

9	Role-play (specific social and academic situations): planning (making notes), understanding nuances of speaking in context,coordinating with situational clues and fellow speakers/participants	Peer discussion for outline, A-V support, observing (teacher modelling), role play (guided), role-play (free), feedback
10	Writing a short reflective report of an event - incident/meeting/celebration	Writing a report on meetings/celebrations/events etc. by actively involved in such events and giving a short oral presentation.
11	Formal Group Discussion on topics of current interest and relevance; focus on effective participation, reflection on control over argument/counter argument, and adherence tothe conventions of formal GD	Noticing strategies from AV modelling, teacher scaffolding thoughopen-house discussion, Note-making(Group work), Group Discussion (free), post-performance discussion,Feedback
12	Speaking spontaneously on topics of interest and writing short structured essays on the same topicsadopting appropriate academic conventions and grammatical accuracy. Make sure to write accurate paragraph and essay by following: cohesion and coherence, topic sentence, introduction and conclusion	Reading for task preparation, note-making, reflection and corrective peer andteacher feedback. Practice paragraph and essay writing in groups; maintain rubrics of writing

Reference Books

1. P. Kiranmayi Dutt, Geetha Rajeevan. (2007). Basic Communication Skills. FoundationBooks. CUP
2. Harmer, J. (1998). How to teach English. Longman
3. Sanjay Kumar & Pushp Lata. (2018). Communication Skills: A Workbook. OUP.
4. Cambridge IGCSE: English as a Second Language Teacher's Book Fourth Edition.By Peter Lucantoni. CUP (2014).
5. Cambrdige Academic English: An Integrated Skills Course for EAP (Upper Intermediate)By Martin Hewings, CUP (2012)
6. Richards, J.C. and Bohlke, D. (2012). Four Corners-3. Cambridge: CUP.
7. Headway Academic Skills: Reading, Writing, and Study Skills Student's Book, Level-2 bySarah Philpot. OUP
8. Latham-Koenig, C. & Oxenden, C. (2014). American English File. Oxfor: OUP.
9. McCarthy, M. & O' Dell. F. (2016). Academic Vocabulary in Use. Cambridge: CUP

Online Resources

1. https://www.grammarly.com/blog/
2. https://www.nationalgeographic.org/education/
3. https://www.bbc.co.uk/teach/skillswise/english/zjg4scw
4. https://www.englishclub.com/
5. https://www.oxfordlearnersdictionaries.com/
6. https://dictionary.cambridge.org/
7. learnenglishteens.britishcouncil.org
8. https://freerice.com/categories/english-vocabulary

9. http://www.5minuteenglish.com/
10. https://breakingnewsenglish.com/
11. https://www.digitalbook.io/
12. https://librivox.org/

Course Outcomes

- Understand the speaker's point of view in fairly extended talks on general or discipline-specifictopics, and follow simple lines of argument in discussions on familiar contemporary issues. (Bloom's Taxonomy Level/s: 3)

- "Read and demonstrate understanding of articles and reports on limited range of contemporaryissues in which the writers adopt particular stances. Also provide samples of written communication containing fairly complex information and reasons for choices/opinions/stances. (Bloom's Taxonomy Level/s: 2 & 3)"

- Make short presentations on a limited range of general topics using slides, and engage in small group discussions sharing experiences/views on familiar contemporary issues and give reasons for choices/opinions/plans. (Bloom's Taxonomy Level/s: 3 & 4)

- Write clear, fairly detailed text (a short essay) on a limited range of general topics, and subjects of interest, and communicate clearly through email/letter to seek/pass on information or givereasons for choices/opinions/plans/actions. (Bloom's Taxonomy Level/s: 3)

- Reflect on others' performance, give peer feedback on fellow learners' presentations, responsesto writing tasks and reading comprehension questions. (Bloom's Taxonomy Level/s: 5)

CO-PO Mapping:

	PO 1	PO 2	PO3	PO 4	PO 5	PO6	PO 7	PO8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PO 16	PSO 1	PSO 2	PSO3	PSO4
CO1	3	3	3	3	2	1	1	1	2	1	2	1	1	1	1	2	3	1	1	1
CO2	2	2	2	3	3	2	1	1	2	2	1	1	2	1	1	1	3	2	2	1
CO3	2	3	2	3	3	1	3	2	2	2	2	1	2	1	1	2	3	2	2	1
CO4	2	3	3	3	3	1	2	1	2	2	1	1	2	1	1	1	3	2	1	1
CO5	3	3	2	3	3	1	3	2	1	2	1	2	2	1	1	2	3	1	2	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : **ACADEMIC COUNCIL:**

SDG No. & Statement:

SDG 16 Peace and Justice Strong Institutions. Promote peaceful and inclusive societies for sustainable development, provide
access to justice for all and build effective, accountable and inclusive institutions at all levels.
SDG Justification: By relating to people with empathy, employing creative problem-solving strategies and engaging meaningfully in a diverse world will create inclusive societies for sustainable development.

LANG1022	COMMUNICATION SKILLS IN ENGLISH – ADVANCED	L	T	P	S	J	C
		0	0	4	0	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description

Communication Skills in English (Advanced) is the third of the three-level graded courses for the developmental enhancement of communication skills in English. Based on the learning outcomes set in the upper-intermediate syllabus, this course focuses on giving learners exposure to higher levels of skills/input processing (ref. Bloom's taxonomy) and practice in terms of complexity and cognitive engagement. This course includes an advanced level of comprehension i.e. anaytical, evaluative, and extrapolative processing (listening and reading). It involves problem-solving, logical reasoning, and decision-making skills in terms of the application of the learning (speaking/writing) with an awareness of social and personality-based variations in communication. This course provides opportunities for activity-based practice of advanced oraland written communicative skills besides building awareness of the finer nuances of language usefor various purposes. This course emhasizes free writing through meaningfully engaging pre- and post-context-building tasks. There is ample scope for applying critical thinking through simulated activities for effective communication in real-life situations.

Course Objectives

1. Enable learners to listen actively, become aware of tone and attitude in speech, and demonstrate their comprehension of fairly complex lines of argument presented by a variety of speakers in talks/presentations/discussions. (Bloom's Taxonomy Level/s: 2 & 4)

2. Enable learners to become aware of tone and attitude in written texts, and demonstrate theircomprehension of fairly complex lines of argument and points of view presented in a variety of texts by equipping them with upper intermediate to advanced level reading skillsand strategies.

3. Make effective presentations, engage in formal group discussions, and write structured essays/ short reports to highlight the significance of actions/decisions/experiences, and sustain views by providing relevant evidence and argument.

4. Equip learners with the skills and strategies to communicate effectively in speech and writing using the language with a degree of fluency, accuracy and spontaneity, and fairly good grammatical control adopting a level of formality appropriate to the context. Encourage learners to apply their knowledge of language and their communication skills in real life situations.

List of Activities & Tasks for Assessment

S.No.	Tasks	Activities	CO
1	Evaluative and extrapolative reading of a longtext/short text on a current topic related to technology and society, identifying and questioning the author's intention, post- reading discussion in small groups, maintaining group dynamics, arriving at aconsensus. Understanging and inferring the meaning.	Pre-reading group discussion, silent reading (Note-making), modelling (questioning), post-reading reflectionand brief presentation of thoughts/ideas/opinions on the themeof the text	3
2	Debate in pairs based on listening to two recorded contemporary speeches by well-known leaders in different fields. Peer feedback and instructor feedback.	Pre-recorded audio/video for listening,student checklist for noticing keywords/concepts, pre-task orientation (by teacher), pair work, feedback	1
3	Information transfer: Visual to verbal (unfamiliar context); demonstration by teacher, learners' task (guided with scaffolding), learners' task (free), presentation, question-answer (among students), modification, editing, proofreading,and feedback before the final version is done	Pre-reading game/modelling, discussion in small groups, independent writing and feedback	4
4	Expressing opinion on a short argumentative text (e.g. a journal article or a newspaper editorial) and justifying one's opinion/stance; focus on the use of appropriate conventions offormal and polite speech, and managing bias	Listening to group discussions/debates,reading news-paper articles on current issues and expressing opinions in favour or against the topic (in GDs, debates or writing argumentative essays).	3
5	Collaborative writing in groups of 3 -4 on topics that would require data collection andreading followed by recorded peer-reflectionand peer-feedback, group presentation and feedback	Pre-task modelling (peer), general discussion on structure, group work(collaboration), presentation, peer feedback, Open-class discussion	5
6	Writing a statement of purpose Discuss all details about the student academic and professional background, highlighting the student accomplishments,	Reading & discussion of sample statement of purposes. Discuss the content in groups and know whether all mentioned details are present. Do practice writing after lecture and discussion.	2

	goals, and how a student fit to the education applied to.	Make sure to adopt a proper writing style.	

7	Mind-mapping for advanced reading, making correlations across texts, extending the author'spoint of view	Reading texts on abstract topics and comprehending the author's perspectiveby inferring the unknown words' meaning in the context and making notes using mind-map strategy and presenting it orally.	3
8	Handling question and answer sessions after presentations: justifying arguments, taking counter-arguments, agreeing and disagreeingwith rationale	Listening to some lectures, talks, and presentations in the academic seminarsand adapting some strategies to handlethe Q&A sessions using polite and formal expressions to agree or disagree with the statements.	1
9	Learn resume and cover letter format & introduce different interview modes. Modelling an interview: with a panel of fourjudges (peers)	Pre-task activity for orientation/strategies (controlled/guided), Model interview (AV support), Group work (role play), Interview in pair (one-to-one), Interview in group (many -to-one), oral corrective feedback (peer/teacher)	2
10	Speaking on abstract and complex topics beyond his/her own area of interest/field ofstudy, using the language flexibly and effectively.	Reading texts on abstract topics and comprehending the author's perspectives. Similarly, listening to talks and discussions on an abstract topic of other discipline and making short oral presentation by sharingviews and opinions.	3
11	Self-reflection on own speech in context(recorded): tone, pitch, relevance, content; extending the reflections/ideas toothers	Listening to selected general discussions (audios and videos) and observing the language production. Recording own speech on some generaltopic and providing a critical review (self-reflection) on it by focusing on the tone, expressions and relevance ofthe content, etc.	1

12	Collaborative and individual tasks: planning, preparing (preparing an outline, structure, setting objectives, and presenting the plan of action) and executing a mini-project, and submitting a brief report on the same peer and instructor feedback after the planning stage and on completion of the mini project	Pre-task modelling (peer/teacher), general discussion on structure, groupwork (collaboration), oral correction, task distribution, presentation, feedback	5

Reference Books

1. Latham-Koenig, C. & Oxenden, C. (2014). American English File-5. Oxford: OUPRichards,
2. J.C. and Bohlke, D. (2012). Four Corners-4. Cambridge: CUP.
3. Cambrdige Academic English: An Integrated Skills Course for EAP (Advanced) By Martin Hewings and Craig Thaine, CUP (2012)
4. Berlin, A. (2016). 50 Conversation Classes: 50 Sets of Conversation Cards With an Accompanying Activity Sheet Containing Vocabulary, Idioms and Grammar. Poland: CreateSpace Independent Publishing Platform
5. Zemach, D. E., Islam, C. (2011). Writing Paragraphs: From Sentence to Paragraph. Germany: Macmillan Education.
6. Stewart, J. P., Fulop, D. (2019). Mastering the Art of Oral Presentations: Winning Orals, Speeches, and Stand-Up Presentations. United Kingdom: Wiley.
7. Kroehnert, Gary. (2010). Basic Presentation Skills. Sidney: McGraw Hill.
8. Cunninghum, S. & Moor, P. (nd). Cutting Edge (Advanced) With Phrase Builder. Longman Publishers. CUP
9. McCarthy, M & O'Dell, F. (2017). English Idioms in Use (Advanced). Cambridge: CUP.
Online

Resources

1. https://www.grammarly.com/blog/
2. https://www.nationalgeographic.org/education/
3. https://www.bbc.co.uk/teach/skillswise/english/zjg4scw
4. https://www.englishclub.com/
5. https://www.oxfordlearnersdictionaries.com/
6. https://dictionary.cambridge.org/
7. learnenglishteens.britishcouncil.org
8. https://freerice.com/categories/english-vocabulary
9. http://www.5minuteenglish.com/
10. https://breakingnewsenglish.com/
11. https://www.digitalbook.io/

12. https://librivox.org/

Course Outcomes

- Listen to extended lectures, presentations, and discussions on a wide range of contemporary issues and demonstrate understanding of relatively complex lines of argument. (Bloom's Taxonomy Level/s: 2)
- Make presentations using suitable AV aids and engage in formal group discussions on a wide range of topics of contemporary interest, demonstrating awareness of standard/widely accepted conventions. (Bloom's Taxonomy Level/s: 3)
- Read and demonstrate understanding of the writer's stance/viewpoint in articles and reports on a wide range of contemporary issues and discipline-specific subjects. (Bloom's Taxonomy Level/s: 2 & 4)
- Write analytical essays on a wide range of general topics/subjects of interest, and engage in written communication (emails/concise reports) to exchange relatively complex information, giving reasons in support of or against a particular stance/point of view. (Bloom's Taxonomy Level/s: 3 & 4)

- Complete a mini project that necessitates the use of fairly advanced communication skills to accomplish a variety of tasks and submit a report in the given format. (Bloom's Taxonomy Level/s: 4 & 5

CO-PO Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PO 16	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	2	3	2	3	3	1	2	2	2	3	2	2	1	1	1	2	3	3	1	1
CO 2	2	3	2	3	3	1	3	3	3	3	2	2	2	1	1	2	3	3	1	1
CO 3	2	3	1	3	3	2	1	1	2	1	2	2	1	1	1	2	3	3	2	1
CO 4	3	3	3	3	3	2	1	1	3	2	2	2	1	1	1	1	3	3	2	1
CO 5	3	3	3	3	3	3	2	2	3	3	2	2	3	1	1	1	3	3	2	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : **ACADEMIC COUNCIL:**

SDG No. & Statement:

SDG 16 Peace and Justice Strong Institutions. Promote peaceful and inclusive societies for sustainable development, provide
access to justice for all and build effective, accountable and inclusive institutions at all levels.

SDG Justification: By relating to people with empathy, employing creative problem-solving strategies and engaging meaningfully in a diverse world will create inclusive societies for sustainable development.

MFST1001	HEALTH & WELLBEING	L	T	P	S	J	C
		0	0	2	0	0	1*
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

The course provides the students a better understanding of the role of a proper diet in maintenance of human health. This course emphasizes the composition of the food, and will help to understand how toexercise, the role of sports and physical fitness in development of a good health. The course also focuses on the importance of emotional well-being and mindfulness. This course helps in teaching the role of yoga in maintenance of physical balance.

Course Educational Objectives:

- To provide an understanding of the relationship between food and nutrition
- To emphasize the role of exercise, sports and physical fitness in obtaining a good health
- To explain about the mindfulness and emotional well being
- To teach the role of yoga and meditation in maintaining the body balance

UNIT 1

Understand the relationship between Food and Nutrition and how food composition affects nutritional characteristics. Knowledge about regulatory principles in determining diets and recommended daily allowances. Understand how to create personalised diet/nutrition plans.

UNIT 2

Understand how exercise, activity and sports helps in developing good health. Experiential exposure to the role of proper, specific nutritional interventions along with structured activities on developing proper physical health. Practical exercises and assignments in sports and exercise regimes.

UNIT 3

Introduction to emotional wellbeing and mindfulness. Teaching of mindfulness practices to reduce stress, increase relaxation and improve mental wellbeing.

UNIT 4

Introduction to Yoga theory and how Yoga helps in maintaining balance in the body. Practice of Yoga and meditation to improve overall emotional and physical balance. Practical yoga exercises and meditation techniques

Course Outcomes:

By the end of the course, student will

1. Learn the role of nutrition and diet in maintaining a good health
2. understand how the exercise, sports and physical activities will improve health
3. learn mindfulness practices for reducing stress
4. know the importance of yoga and meditation

APPROVED IN:

BOS :01-02-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

PHPY1001	GANDHI FOR THE 21ST CENTURY	L	T	P	S	J	C
		2	0	0	0	0	2*
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides the students with basic knowledge on Gandhi's early life, transformations in South Africa and his entry into India's national movement. While going through the social-political, economic, and educational philosophies of Gandhi, the course analyses how his ideologies are relevant even in the 21st century.

Course Educational Objectives:

The objectives of the course are;

- To provide the students with the basic knowledge on Gandhi's life and his philosophies
- To understand the early influences and transformations in Gandhi
- To analyse the role of Gandhi in India's national movement
- To apply Gandhian Ethics while analysing the contemporary social/political issues
- To appreciate the conflict resolution techniques put forward by Gandhi and its significance in thecurrent scenario.

UNIT 1 MK Gandhi: Childhood and Education

M K Gandhi, Formative Years (1869-1893): Early childhood - study in England - Indian influences, early Western influences.

UNIT 2 From Mohan to Mahatma-South African Experiences

Gandhi in South Africa (1893-1914): South African Experiences - civil right movements in South Africa - invention of Satyagraha - Phoenix settlement- Tolstoy Farm - experiments in Sarvodaya, education, and sustainable livelihood.

UNIT 3 Gandhi and Indian National Movement

Gandhi and Indian National Movement (1915-1947): Introduction of Satyagraha in Indian soil -non- cooperation movement - call for women's participation - social boycott - Quit-India movement - fighting against un-touchability - Partition of India- independence.

UNIT 4 Gandhi and Sustainable Development

Gandhian Constructive Programs-Eleven Vows-Sarvodaya-Seven Social Sins-Gandhian Economics and Sustainable Development

UNIT 5 Gandhi and Contemporary Issues

Conflict Resolution Techniques of Gandhi-Ecological Challenges and Gandhian solutions-Gandhian Ethics-An Analysis

References:

1. Gandhi, M K. (1941). *Constructive Programme*. Ahmadabad: Navjivan Publishing House
2. Gandhi, M. K. (1948). *The Story of My Experiments with Truth*. Ahmadabad: Navjivan PublishingHouse
3. Gandhi, M K. (1968). *Satyagraha in South Africa*. Ahmadabad: Navjivan Publishing House.
4. Khoshoo, T N (1995). *Mahatma Gandhi: An Apostle of Applied Human Ecology*. New Delhi:TERI
5. Kripalani, J.B. (1970). *Gandhi: His Life and Thought*. New Delhi: Publications Division.
6. Narayan, Rajdeva (2011). *Ecological Perceptions in Gandhism and Marxism*. Muzaffarpur:NISLS
7. Pandey, J. (1998). *Gandhi and 21st Century*. New Delhi: Concept.
8. Weber, Thomas (2007).Gandhi as Disciple and Mentor. New Delhi: CUP

Course Outcomes:

After the successful completion of the course the students will be able to;

1. Understand the life of Gandhi
2. Appreciate the role of Gandhian non-violence and Satyagraha in India's freedom struggle.
3. Critically examine the philosophy of Gandhi on Education, Sarvodaya, and Satyagraha
4. Analyse the contemporary significance of Gandhian constructive programmes and eleven vows
5. Examine the possible solutions for some of the contemporary challenges like environmentalissues, moral degradation and ethical dilemmas.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	3	3	3	3	2	2	3	3	3	3
CO2	3	3	2	3	2	3	3	3	3	2	3	2	3	2	3
CO3	3	3	3	2	3	2	2	3	3	2	2	3	2	3	2
CO4	3	2	2	3	3	2	2	3	3	2	3	2	3	3	2
CO5	3	3	2	2	3	3	3	3	3	3	2	2	2	3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :01-02-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG-4: Ensure Inclusive And Equitable Quality Education And Promote Lifelong Learning Opportunities For All.
Sdg-8: Promote Sustained, Inclusive And Sustainable Economic Growth, Full And Productive Employment And Decent Work For All

SDG Justification:

Statement: This course promotes the education for all the people without considering their religion, caste, gender and regional differences.

Statement: This course deals with the basic concepts of national income and employment to understand the national level scenario of how an economy is growing and providing employment.

POLS1001	Indian Constitution and History	L	T	P	S	J	C
		2	0	0	0	0	2*
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course analyzes the basic structure and operative dimensions of the Indian Constitution. It explores various aspects of the Indian political and legal system from a historical perspective highlighting the various events that led to the making of the Indian Constitution. The course also deals with various challenges faced by the constitution and its coping mechanisms. Broadly, the students would understand and explain the working of different institutions and political debates ensuing from the operation of the Indian constitution in action.

Course Educational Objectives:

- To introduce constitutional history of India.
- To explain the process of making Indian constitution
- To analyze Fundamental of Rights, Duties and other principles in constitution
- To create familiarity with political developments which shaped the constitution.

UNIT 1 India as a Nation 6 hours

Khilani, S. (2004). *Introduction, The Idea of India*, Chapter 1. New Delhi: Penguin Books, pp. 1-15.

Rowat, D. (1950). 'India: The Making of a Nation', International Journal, 5(2), 95-108. doi:10.2307/40194264

Brass, P. (2018). 'Continuities and Discontinuities between pre- and post-Independence India', Chapter 1.

The Politics of Idea since independence, New Delhi: Cambridge University Press. pp. 1-30.

UNIT 2 Understanding the Constitution 6 hours

Mehta, U.S. (2011). 'Constitutionalism' in *The Oxford Companion to Politics in India*, (ed) by Nirja Gopal Jayal, and Pratap Bhanu Mehta, New Delhi: Oxford University Press. pp. 15-27.

Austin, G. (2016), 'The Constituent Assembly: Microcosm in Action' *in The Indian Constitution: Cornerstone of a Nation*, New Delhi: Oxford University Press, pp. 1-25.

Beteille, Andre (2008): "Constitutional Morality," *Economic and Political Weekly*, Vol 43, Issue No 40

Prahladan, Vivek (2012): "Emergence of the Indian Constitution," *Economic and Political Weekly*, Vol 47, Issue No 07.

UNIT 3 The Preamble, Fundamental Rights and Directive Principles of State Policy 6 hours

Bhakshi, P.M. (2011). 'Preamble' in *The Constitution of India*, New Delhi: Universal Law. Pp. 1-5. Laxmikanth, M. (2017). 'Chapter IV: Preamble of the Constitution' in *Indian Polity*, Chennai: McGraw Hills.

Kumar, Virendra (2007): "Basic Structure of The Indian Constitution: Doctrine of Constitutionally Controlled Governance [From Kesavananda Bharati to I.R. Coelho]" *Journal of the Indian Law Institute*, Vol 49, No 3, pp 365-398.

Austin, G (2016), ' ' in *The Indian Constitution: Cornerstone of a Nation*, New Delhi: Oxford University Press, pp.63-105.

Reddy, S (1980). Fundamental Ness of Fundamental Rights and Directive Principles in the Indian Constitution. *Journal of the Indian Law Institute*, 22(3), pp. 399-407.

Bhatia, Gautam (2017): "The Supreme Court's Right to Privacy Judgement," *Economic and Political Weekly*, Vol 52, Issue No 44

UNIT 4 Citizenship 6 hours

Jayal, N.G. (2019). 'Reconfiguring citizenship in contemporary India' in *South Asia Journal of SouthAsian Studies*, pp.33-58.

Roy, Anupama. (2010). 'Chapter I: Enframing the citizen in contemporary times' in *Mapping Citizenship in India*, New Delhi: Oxford University Press.

Das, Veena (2010): "State, Citizenship and the Urban Poor," *Citizenship Studies,* Vol 15, pp 319-333.Valerian Rodrigue

UNIT 5 Separation and Distribution of Powers 6 hours

Pal, Ruma. (2016). 'Separation of Powers' in *The Oxford Handbook of the Indian Constitution*, (ed) by Sujit Choudhry, Madhav Khosla, and Pratap Bhanu Mehta, Delhi: Oxford University Press.

Bakshi, P. (1956). 'Comparative Law: Separation of Powers in India'. *American Bar Association Journal, 42*(6), 553-595.

Rao, P. (2005). 'Separation of Powers in a Democracy: The Indian Experience'. *Peace Research, 37*(1),113-122.

Kumar, Ashwani (2019): "Constitutional Rights, Judicial Review and Parliamentary Democracy,"

Economic and Political Weekly, Vol 51, Issue 15

Tillin, Louise. (2015). 'Introduction' in *Indian Federalism*. New Delhi: Oxford University Press. pp.1-30.

Chakrabarty, Bidyut and Rajendra Kumar Pandey. (2008). *Federalism' in Indian Government andPolitics*, New Delhi: Sage Publications. pp. 35-53.

Arora, B. and Kailash, K. K. (2018). 'Beyond Quasi Federalism: Change and Continuity in IndianFederalism', in *Studies in Indian Politics*, pp. 1-7.

Agrawal, Pankhuri (2020): "COVID-19 and dwindling Indian Federalism," *Economic and PoliticalWeekly,* Vol 55, Issue No 26

Recommended Readings:

De, Rohit. (2018). *A People's Constitution – The Everyday Life of Law in the Indian Republic*, USA:Princeton University Press.

Granville Austin, *The Indian Constitution: Cornerstone of a Nation*, Oxford University Press, Oxford, 1966.

Lahoti, R.C. (2004). *Preamble: The Spirit and Backbone of the Constitution of India*. Delhi: EasternBook Company.

Rajeev Bhargava (ed), *Ethics and Politics of the Indian Constitution*, Oxford University Press, NewDelhi, 2008.

Subhash C. Kashyap, *Our Constitution*, National Book Trust, New Delhi, 2011.Tillin, Louise. (2015). *Indian Federalism*. New Delhi: Oxford University Press.

Zoya Hassan, E. Sridharan and R. Sudarshan (eds), *India's Living Constitution: Ideas, Practices,Controversies*, Permanent Black, New Delhi, 2002.

Course Outcomes:

On the successful completion of the course students would be able to:

1. Demonstrate an understanding of the Constitution of India and how constitutional governance iscarried out in India
2. Interpret knowledge of the Fundamental Rights and Duties of the Citizens as well as theObligation of the state towards its citizens
3. Correlate familiarity with key political developments that have shaped the

Constitution andamended it from time to time.
4. Equip themselves to take up other courses in law after having done a foundation course on IndianConstitution

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	2	2	3	3	2	3	1	2	1	2	1	2
CO2	1	1	2	1	2	2	3	2	3	1	2	1	1	2	1
CO3	1	2	1	2	2	2	3	1	3	1	1	1	2	1	2
CO4	1	1	1	2	2	2	3	1	3	1	1	1	1	1	2
CO5	1	1	1	2	2	2	3	2	3	1	2	1	1	1	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :01-02-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG-16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.

SDG Justification:

The course primarily talks about evolution of the constitutional institutions. Since the SDG-16 talks about the quality of the institutions, it is applicable here.

VEDC1001	VENTURE DEVELOPMENT	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

India as part of its "Make in India" initiative has been focusing on creating incubation centers within educational institutions, with an aim to generate successful start-ups. These start-ups will become employment creators than employment seekers, which is the need of the hour for our country. This common course (university core) for all the disciplines is a foundation on venture development. It is an experiential course that starts with students discovering their deeper self in terms of how they might contribute to society by creating exciting new products and services that can become the basis of real businesses. The students learn about the emerging areas of knowledge that are the foundations of any successful company. They will learn how to develop insight into the problems and desires of different types of target customers, and from this, to identify the design drivers for a specific innovation. Students will learn specific design methods for new products and services. The students will learn that as important as the product or service itself, is a strategy for monetizing the innovation – for generating revenue, structuring the operating costs, and creating the operating profit needed to support the business, hire new employees, and expand forward. This course is aimed to be the beginning of what might be the most important journey of personal and career discovery so far in a student's life, one with lasting impact. This is not just a course, but potentially, an important milestone in life that a student remembers warmly in the years to come.

Course Educational Objectives:

Students have the opportunity to:

- Discover who they are – Values, Skills, and Contribution to Society
- Understand how creativity works and permeates the innovation process
- Learn the basic processes and frameworks for successful innovation.
- Gain experience in going through the innovation process.
- Conduct field research to test or validate innovation concepts with target customers.

UNIT 1 PERSONAL DISCOVERY 4 hours

Personal Values, Excite & Excel, Build a Team, Define Purpose, Mission Statement

UNIT 2 IDEATION 10 hours

Ideation & Impact, User Insights - Frameworks, Customer Interviews, Interpreting Results

UNIT 3 SOLUTION DISCOVERY 8 hours

Concept Design, Competitive Analysis, Product Line Strategy, Prototyping Solutions, Reality Check

UNIT 4 BUSINESS MODEL DISCOVERY 4 hours

Understand the Industry, Types of Business Model, Define Revenue Models, Define Operating Models, Define Customer Journey, Validate Business Model

UNIT 5 DISCOVERY INTEGRATION

Define Company Impact, Create Value, Tell Your Story

L – 15; Total Hours – 30

Textbooks:

1. Meyer and Lee, "Personal Discovery through Entrepreneurship", The Institute for Enterprise Growth, LLC. Boston, MA., USA.

References:

1. Adi Ignatius (Editor-in-Chief), "Harvard Business Review", Harvard Business Publishing, Brighton, Massachusetts,2021

Course Outcomes:

1. Identify one's values, strengths and weaknesses and their will to contribute to the society
2. Formulate an idea and validate it with customers
3. Demonstrate prototyping and analyse the competition for the product
4. Create business models for revenue generation and sustainability of their business
5. Come up with a pitch that can used as the basis for actually starting a company based on an impactful innovation and societal impact

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1						3	1	3	3	3		3			
CO2		3		3	1	3	2	1	3	3	1	3			
CO3	1	3	3		3		3		3	1	3	3			
CO4					1	1	3	3	3	1	3	1			
CO5					3	3			3	3	3	3			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :<< date >> **ACADEMIC COUNCIL: <<date>>**

SDG No. & Statement:

4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

17. Strengthen the means of implementation and revitalize the global partnership for sustainable development.

SDG Justification:

4. The course involves identifying one’s personal values and working on real-life problems, thus forming the base to work on their passions even past the collegiate life.

17. The course is developed in collaboration with North-eastern University, USA and the training for the champions is being by North-eastern University.

Faculty Core

CHEM1001	CHEMISTRY	L	T	P	S	J	C
		2	1	2	0	0	4
Pre-requisite	Nil						
Co- requisite	Nil						
Preferable exposure	Nil						

Course Description:

This course enables the students to gain knowledge on various aspects of Water and its treatment, electrochemical energy systems, Construction of batteries, renewable energy sources, Semiconductors, Steel, Cement and Polymers, Corrosion and its control, nanomaterials, Analytical instruments, and applications. The knowledge gained in this course can be applied to the latest developments in technology.

Course Educational Objectives:

1. To impart knowledge on various aspects of water and its treatment.
2. To study about electrochemical energy systems, renewable energy sources, solar cells, and their applications.
3. To gain knowledge on materials such as steel, cement, and polymers
4. To create awareness on corrosion and its control.
5. To introduce different types of nanomaterials.
6. To expose the students to latest instrumental techniques such as scanning electronic microscope (SEM) & transmission electron microscope (TEM).

UNIT 1 Water and its treatment 9 Hours

Water and its treatment: Introduction – hardness of water – Causes of hardness - Types of hardness: temporary and permanent – expression and units of hardness. Estimation of hardness of water by complexometric method. Potable water and its specifications. Steps involved in treatment of water – Disinfection of water by chlorination and ozonization-industrial water treatment- Boiler feed water and its treatment -internal conditioning– Calgon and Phosphate conditioning. External treatment of water – Ion exchange process. Desalination of water – Reverse osmosis.

UNIT 2 Electrochemical Energy Systems 9 Hours

Battery Technology: Basic concepts, battery characteristics, classification of batteries, Important applications of batteries, Classical batteries-dry/Leclanche cell, Modern batteries-zinc air, Lead-acid storage battery, lithium cells- Lithium-ion cell, Li MnO_2 cell. Fuel cells- Introduction - classification of fuel cells – hydrogen and oxygen fuel cell, propane, and oxygen fuel cell- Merits of fuel cell. **Renewable energy sources – Types of renewable energy sources. Semiconductors:** Definition, types of semiconductors: doping- n type and p – type semiconductors and applications. - **Solar cells:** Introduction, harnessing solar energy, Photovoltaic cell, solar water heaters.

UNIT 3 Engineering materials and Polymer Chemistry 8 Hours

Steel – Types of Steel, chemical composition – applications of alloy steels

Cement: Portland cement, constituents, Manufacture of Portland Cement, chemistry of setting and hardening of cement (hydration, hydrolysis, equations).

Polymer Chemistry: Concept of polymerization – Types of Polymerizations, Chain growth polymerization – mechanisms of free radical and cationic polymerizations, Thermoplastic resins and Thermosetting resins: examples- Polyethylene, Styrene, Nylon 6,6 and Bakelite. and applications, Conducting polymers:– Examples – and applications.

UNIT 4 Corrosion and its control 8 Hours

Corrosion and Its Prevention: Electrochemical theory of corrosion, Corrosion due to dissimilar metal cells (galvanic cells), Corrosion due to differential aeration cells, Uniform corrosion, pitting corrosion and stress corrosion cracking, Effect of pH, temperature and dissolved oxygen on corrosion rate. Corrosion prevention and control by cathodic protection- protective coatings- paints.

UNIT 5 Nanomaterials and Analytical Instrumental Techniques 8 Hours

Nanomaterials: Introduction to nanomaterial: nanoparticles, nanocluster, carbon nanotube (CNT) and nanowires. Chemical synthesis of nanomaterials: sol-gel method. Characterization: Principle and applications of scanning electron microscope (SEM) and transmission electron microscope (TEM)

Analytical Instrumental Techniques

Review of electromagnetic spectrum, Quantization of energy. Absorption of radiation: Beer-Lambert's law. Principle and applications of pH metry, potentiometry, conductometry, IR and UV-spectroscopy with examples.

Text Books:

1. P.C. Jain and M. Jain, Engineering Chemistry, 15/e, Dhanapat Rai & Sons, Delhi (2014).
2. B.K. Sharma, Engineering Chemistry, Krishna Prakashan, Meerut.
3. O G Palanna, Engineering Chemistry, Tata McGraw Hill Education Private Limited, (2009).

References:

1. Sashi chawla, A Textbook of Engineering Chemistry, Dhanapath Rai and sons, (2003)
2. B.S Murthy and P. Shankar, A Text Book of NanoScience and NanoTechnology, University Press (2013).
3. S.S. Dara, A Textbook of Engineering Chemistry, S.Chand & Co, (2010)
4. N.Krishna Murthy and Anuradha, A text book of Engineering Chemistry, Murthy Publications (2014).
5. K. Sesha Maheshwaramma and Mridula Chugh, Engineering Chemistry, Pearson India Edn services, (2016).

Course Outcomes:

After the completion of the course, the student will be able to

1. List the important purification methods of water.
2. Illustrate the principles and applications of batteries, solar energy.
3. Explain the importance of materials such as steel, cement, and polymers

4. Identify different protective coatings.
5. Analyze the importance of nano materials and the principles of SEM and TEM.

CHEMISTRY LABORATORY

List of Experiments:

1. Determination of Mohr's salt by potentiometric method
2. Determination of strength of an acid by pH metric method
3. Determination of conductance by conductometric method
4. Determination of viscosity of a liquid
5. Determination of surface tension of a liquid
6. Determination of sulphuric acid in lead-acid storage cell
7. Determination of chromium (VI) in potassium dichromate
8. Determination of copper in a copper ore
9. Determination of Zinc by EDTA method.
10. Estimation of active chlorine content in Bleaching powder
11. Preparation of Phenol-Formaldehyde resin
12. Preparation of Urea-Formaldehyde resin
13. Thin layer chromatography
14. Preparation of TiO2/ZnO nano particles
15. SEM analysis of nano materials

Textbooks:

1. Mendham J, Denney RC, Barnes JD, Thosmas M and Sivasankar B Vogel's Quantitative Chemical Analysis 6/e, Pearson publishers (2000).
2. N.K Bhasin and Sudha Rani Laboratory Manual on Engineering Chemistry 3/e, Dhanpat Rai Publishing Company (2007).

Course Outcomes:

After the completion of the laboratory course, the student will be able to

1. explain the functioning of the instruments such as pH, Conductometric and Potentiometric methods.
2. identify different ores (Cr & Cu) and their usage in different fields (industry, software devices, electronic goods).
3. experiment with the physical parameter of organic compounds.
4. compare the viscosities of oils.
5. list the preparation of polymers and nano materials.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	2	2	2	3	1	1	2	2	3	1	3	2
CO2	3	2	1	1	3	3	3	2	1	1	3	3	1	3	3
CO3	3	2	1	1	2	3	2	2	1	1	2	3	3	1	2
CO4	3	2	2	1	2	3	3	2	2	1	2	3	3	2	2
CO5	2	2	1	2	3	3	2	2	1	2	3	2	3	1	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

CSEN1011	PROBLEM SOLVING AND PROGRAMMING WITH C	L	T	P	S	J	C
		0	0	6	0	0	3
Pre-requisite	Nil						
Co-requisite	Nil						
Preferable exposure	Familiarity with Computer system and its operation.						

***Course Description**:*
The course is designed to enable the student to write programs for problem solving. After an introduction to program logic design using algorithms and flowcharts, converting the logic into programs is taught. The features of structured programming are explained with the C programming language as an example. This course lays the foundation both for developing program logic and for writing programs in C according to the developed logic.

Course objectives:
1. Familiarize the student with the steps involved in writing and running a compiled program.
2. Enable the student to build program logic with algorithms and flowcharts.
3. Explain with the features and constructs of C programming such as data types, expressions, loops, functions, arrays, pointers, and files.
4. Demonstrate the handling of variables and input-output operations in C.
5. Train the student to convert program logic into C language code using a top-down approach.

Module I: Introduction to Computer Problem-Solving 12Hours
Introduction, the Problem-Solving Aspect, Top-Down Design, Introduction to the idea of an algorithm, Introduction to Flowchart using Raptor tool.
Introduction to C Language – Structure of a C Program, Keywords, Identifiers, Data Types (int, float, char, unsigned int) and Variable declaration, Constants, Input / Output function. Operators, Expressions, Precedence and Associativity, Expression Evaluation, Type conversions.
Exercises: Construct a flowchart and write a program to
- Develop a calculator to convert time, distance, area, volume and temperature from one unit to another.
- Calculate simple and compound interest for various parameters specified by the user
- To enter marks of five subjects and calculate total, average and percentage.
- Calculate net salary of employee given basic,da,hra,pf and lic
- retrieve remainder after division of two numbers without using mod operator
- Convert an upper-case character to a lower-case character.
- Swap two numbers
- Enter two angles of a triangle and find the third angle.
- Check Least Significant Bit (LSB) of a number
- Input any number from user and check whether nth bit of the given number is set (1) or not (0)(hint: Use bitwise operators)

Module II: Control Structures 15 Hours

- **Control Structures:** Selection Statements (making decisions) – if, if-else, nested if, else if ladder and switch statements. Repetition statements (loops)-while, for, do-while statements, Nested Loops.
- Unconditional statements-break, continue, goto.
- Pointers – Pointer variable, pointer declaration, Initialization of pointer, accessing variables through pointers, pointers to pointers, pointers to void.

Exercises: Construct a Flowchart and Write a Program to

- Check whether the triangle is equilateral, isosceles, or scalene triangle.
- Check whether entered year is a leap year or not
- Find minimum among three numbers.
- Check whether a number is divisible by 5 and 11 or not.
- Check whether a number is positive, negative or zero using switch case.
- Design a calculator that performs arithmetic operations on two numbers using switch case
- Find Roots of a Quadratic Equation
- Find factorial of a number
- Check whether number is a palindrome or not
- Check whether number is perfect or not
- Convert a decimal number to binary number
- To find the sum of the series [1-X^2/2!+X^4/4! ....].
- Print following patterns

```
*
*
* *
* * *
* * * *
A
B B
C CC
D D D D
E E E EE
1
2 3
4 5 6
7 8 9 10
```

- Calculate the greatest common divisor of two numbers
- Generate first n numbers in the Fibonacci series
- Generate n prime numbers
- Swap two numbers using pointers.
- Performs all the five arithmetic operations using Pointers.

Module III: Functions 15 Hours

Functions-Designing Structured Programs, user defined function- function definition, function prototype, function call, Types of functions. Parameter Passing by value, parameter passing by address, Recursive functions. Dynamic Memory allocation Functions, pointers to functions. Storage classes-auto, register, static, extern.

Exercises: Write a program using functions to

- Print even and odd numbers in a given range
- Find power of a number
- Return maximum of given two numbers
- To print all strong numbers between given interval using functions.
- Check whether a number is prime, Armstrong or perfect number using functions.
- Demonstrate call by value and call by reference mechanisms.
- Find power of any number using recursion.
- Generate Fibonacci series using recursion
- Find product of two numbers using recursion
- Find the sum of digits of a number. Number must be passed to a function using pointers.
- Find GCD (HCF) of two numbers using recursion.
- Find LCM of two numbers using recursion.

Module IV: Arrays and Strings 15 Hours

Arrays – Declaration and Definition of Array, accessing elements in array, Storing values in array, linear search, binary search, bubble sort, Two – dimensional arrays, multidimensional arrays. Arrays and Pointers, Pointer Arithmetic and arrays, array of pointers, Passing array to function.

Strings – Declaration and Definition of String, String Initialization, unformatted I/O functions, arrays of strings, string manipulation functions, string and pointers.

Exercises: Write a program to

- Find minimum and maximum element in an array
- Implement linear search.
- Sort an array in descending order.
- Given a two-dimensional array of integers and a row index, return the largest element in that row.
- Find transpose of a matrix.
- Perform multiplication of two matrices
- Count total number of vowels and consonants in a string.
- Reverse the given string without using String handling functions.
- Sort strings in dictionary order
- To perform addition of two matrices.
- Read an array of elements of size 'n' and find the largest and smallest number using functions
- find total number of alphabets, digits or special character in a string using function

Module V: Structures and Files 15Hours

Structures–Declaration, initialization, accessing structures, operations on structures, structures containing arrays, structures containing pointers, nested structures, self-referential structures, arrays of structures, structures and functions, structures and pointers, unions.

Files – Concept of a file, Opening and Closing files, file input / output functions (standard library input / output functions for text files)

Exercises: Write a program to

- Store information of a student using structure
- Add two complex numbers by passing structures to a function

- Store information of 10 students using structures
- Store Employee information using nested structure
- Read file contents and display on console.
- Read numbers from a file and write even and odd numbers to separate file.
- Count characters, words and lines in a text file.

Textbooks(s)

- B. A. Forouzan and R. F. Gilberg, Computer Science: A Structured Programming Approach Using C, 3/e, Cengage Learning

Reference Book(s)

1. Jeri R Hanly, Elliot B Koffman, Problem Solving and Program Design in C, 7/e, Pearson Education, 2012.
2. B.W. Kernighan and Dennis M. Ritchie, The C Programming Language, 2/E, Pearson education, 2015.
3. B. Gottfried, Programming with C, 3/e, Schaum's outlines, McGraw Hill (India), 2017.
4. P. Dey and M Ghosh, Programming in C, 2/e, Oxford University Press, 2011.

Additional Exercises:

1. Given numbers x, y, and target, return whichever of x and y is closer to the target. If they have the same distance, return the smaller of the two
2. There are three friends Ram, Raheem and Robert. Ram's age is 20, Raheem is aged three times more than his friend Ram. After 8 years, he would be two and a half times of Ram's age. After further 8 years, how many times would he be of Rams age? Robert's age is 25 now. Now program your computer to determine the final ages of all the three people after 16 years and also show who is elder.
3. Given an actual time and an alarm clock time, both in "military" format (such as 0730 for 7:30am), print how many more minutes before the alarm rings. But if the time is after the alarm, print "Alarm already went off".
4. Let there be a scenario where you and your friend are going to a restaurant. You have lunch there every fourth day, and he has his lunch there every sixth day. How many days before you meet again for lunch at the same restaurant?
5. Two friends Suresh and Ramesh have **m** red candies and **n** green candies respectively. They want to arrange the candies in such a way that each row contains equal number of candies and also each row should have only red candies or green candies. Help them to arrange the candies in such a way that there are maximum number of candies in each row.
6. On a chessboard, positions are marked with a letter between a and h for the column and a number between 1 and 8 for the row. Given two position strings, return true if they have the same colour.
7. Given two strings s0 and s1, return whether they are anagrams of each other.
8. Write a program to encrypt and decrypt a password which is alphanumeric
9. Given a string, return the string with the first and second half swapped. If the string has odd length, leave the middle character in place.
10. Given an array of integers, return the second-largest element.
11. Given lists of integers people, jobs, profits. Each person i in people have people[i] amount of strength, and performing job j requires jobs[j] amount of strength and nets profits[j] amount of profit. Given that each person can perform at most one job, although a job can be assigned to more than one person, return the maximum amount of profit that can be attained.

12. Mr. Roxy has arranged a party at his house on the New Year's Eve. He has invited all his friends - both men and women (men in more number). Your task is to generate the number of ways in which the invitees stand in a line so that no two women stand next to each other. Note that the number of men is more than the number of women and Roxy doesn't invite more than 20 guests. If there are more than 20 guests or an arrangement as per the given constraints is not possible, print 'invalid'.
13. Two friends have entered their date of birth and they want to know who is elder among them. Make a structure named Date to store the elements day, month and year to store the dates.

Case Study:

1. Create a structure containing book information like accession number, name of author, book title and flag to know whether book is issued or not. Create a menu in which the following functions can be done: Display book information, Add a new book, Display all the books in the library of a particular author, Display the number of books of a particular title, Display the total number of books in the library, Issue a book (If we issue a book, then its number gets decreased by 1 and if we add a book, its number gets increased by 1)

2. Ranjan is maintaining a store. Whenever a customer purchases from the store, a bill is generated. Record the customer name, amount due, the amount paid, mobile number with purchased items in file. At the end of day print the total income generated by store.
3. Contact Management System- Create structure to store Contact information like name, gender,mail,phone number and address. Users can add new contact and can also edit and delete existing contact. (Hint: Use Files to store data)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS12	PSO1	PSO2	PSO3
CO1	2	3	2		1				2			2	3	2	2
CO2	2	2	2		1				2			2	2	2	2
CO3	2	3	2		1				2			2	2	2	2
CO4	2	3	2		1				2			2	3	2	2
CO5	2	2	2		1				2			2	2	2	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : September 6, 2021 **ACADEMIC COUNCIL: 21st AC(September 17, 2021)**

SDG No. & Statement: 4 Quality Education, Decent Work and Economic Growth

4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

SDG Justification:

Learning various problem-solving techniques will lead to become a good problem solver.

CSEN1021	PROGRAMMING WITH PYTHON	L	T	P	S	J	C
		0	0	6	0	0	3
Pre-requisite	Nil						
Co-requisite	Nil						
Preferable exposure	Familiarity with Computer system and its operation.						

Course Educational objectives:

1. To elucidate problem solving through python programming language
2. To introduce function-oriented programming paradigm through python
3. To train in development of solutions using modular concepts
4. To teach practical Python solution patterns

Module I: Introduction to Python 18 **Hours**

Python – Numbers, Strings, Variables, operators, expressions, statements, String operations, Math function calls, Input/output statements, Conditional If, while and for loops.

Exercises:

1. Accept input from user and store it in variable and print the value.
2. Use of print statements and use of (.format)for printing different data types.
3. Take 2 numbers as user input and add, multiply, divide, subtract, remainder and print the output (Same operations on floating point input as well)
4. Conversion of one unit to another (such as hours to minutes, miles to km and etc)
5. Usage of mathematical functions in python like math.ceil, floor, fabs, fmod, trunc, pow, sqrt etc.
6. Building a mathematical calculator that can perform operations according to user input. Use decision making statement.
7. Accepting 5 different subject marks from user and displaying the grade of the student.
8. Printing all even numbers, odd numbers, count of even numbers, count of odd numbers within a given range.
9. a) Compute the factorial of a given number. b) Compute GCD of two given numbers. c) Generate Fibonacci series up to N numbers.
10. Check whether the given input is a) palindrome b) strong c) perfect
11. Compute compound interest using loop for a certain principal and interest amount

Module II: Functions **18 Hours**

User defined Functions, parameters to functions, recursive functions. Lists, Tuples, Dictionaries, Strings.

Exercises:

- Create a function which accepts two inputs from the user and compute ${}^{n}C_{r}$
- Recursive function to compute GCD of 2 numbers
- Recursive function to find product of two numbers
- Recursive function to generate Fibonacci series
- Program to print a specified list after removing the 0th, 4th and 5th elements.
  Sample List : ['Red', 'Green', 'White', 'Black', 'Pink', 'Yellow']
  Expected Output : ['Green', 'White', 'Black']
- Program to get the difference between the two lists.
- Program to find the second smallest number and second largest number in a list.
- Given a list of numbers of list, write a Python program to create a list of tuples having first element as the number and second element as the square of the number.
- Given list of tuples, remove all the tuples with length K.
  Input : test_list = [(4, 5), (4,), (8, 6, 7), (1,), (3, 4, 6, 7)], K = 2
  Output : [(4,), (8, 6, 7), (1,), (3, 4, 6, 7)]
  Explanation : (4, 5) of len = 2 is removed.
- Program to generate and print a dictionary that contains a number (between 1 and n) in the form (x, x*x).
  Sample Input: (n=5) :
  Expected Output : {1: 1, 2: 4, 3: 9, 4: 16, 5: 25}
- Program to remove a key from a dictionary
- Program to get the maximum and minimum value in a dictionary.
- Program to perform operations on string using unicodes ,splitting of string,accessing elements of string using locations
- Program for Counting occurrence of a certain element in a string, getting indexes that have matching elements.For ex -.In Rabbit count how many times b has occurred . Example-I have to go to a doctor and get myself checked. Count the number of occurrences of 'to'.
- Program for replacing one substring by another For example - Rabbit - Replace 'bb' by 'cc'
- Program to Acronym generator for any user input (ex-input is Random memory access then output should be RMA).Example - Random number (RN)
- Python function that accepts a string and calculates the number of uppercase letters and lowercase letters.
- Program to count the number of strings where the string length is 2 or more and the first and last character are same from a given list of strings

  Sample List : ['abc', 'xyz', 'aba', '1221'] Expected Result : 2

Module III: Files and Packages 18 Hours

Files—Python Read Files, Python Write/create Files, Python Delete Files.

Pandas -- Read/write from csv, excel, json files, add/ drop columns/rows, aggregations, applying functions.

Exercises

- read an entire text file.
- read the first n lines of a file.
- append text to a file and display the text.
- Read numbers from a file and write even and odd numbers to separate files.
- Count characters, words and lines in a text file.
- To write a list to a file.
- Given a CSV file or excel file to read it into a data frame and display it.
- Given a data frame, select rows based on a condition.
- Given is a data frame showing the name, occupation, salary of people. Find the average salary per occupation.
- To convert Python objects into JSON strings. Print all the values.
- Write a Pandas program to read specific columns from a given excel file.

Module IV: Operations in database with suitable libraries **18 Hours**

SQLite3: CRUD operations (Create, Read, Update, and Delete) to manage data stored in a database.

Matplotlib -- Visualizing data with different plots, use of subplots. User defined packages, define test cases.

Exercises

Special commands to sqlite3 (dot-commands)
Rules for "dot-commands"
Changing Output Formats
Querying the database schema
Redirecting I/O
Writing results to a file
Reading SQL from a file
File I/O Functions
The edit() SQL function
Importing CSV files
Export to CSV
Export to Excel

Reference - https://www.sqlite.org/cli.html

Matplotlib can be practiced by considering a dataset and visualizing it.
It is left to the instructor to choose appropriate dataset.

Module V: Regular Expressions **18 Hours**

Regular expression: meta character, regEx functions, special sequences, Web scrapping, Extracting data.

Exercises

Write a Python program to check that a string contains only a certain set of characters (in this case a-z, A-Z and 0-9).
Write a Python program that matches a string that has an a followed by zero or more b's
Write a Python program that matches a string that has an a followed by one or more b's
Write a Python program that matches a string that has an a followed by zero or one 'b'
Write a Python program that matches a string that has an a followed by three 'b'
Write a Python program to find sequences of lowercase letters joined with an underscore

Write a Python program to test if a given page is found or not on the server.
Write a Python program to download and display the content of robot.txt for en.wikipedia.org.
Write a Python program to get the number of datasets currently listed on data.gov
Write a Python program to extract and display all the header tags from en.wikipedia.org/wiki/Main_Page
.
Textbooks(s)

1. Programming with python, T R Padmanabhan, Springer
2. Python Programming: Using Problem Solving Approach, Reema Thareja, Oxford University Press

Reference Book(s)

1. Programming with python, T R Padmanabhan, Springer
2. Python Programming: Using Problem Solving Approach, Reema Thareja, Oxford University Press
3. Python for Data Analysis, Wes McKinney, O.Reeilly

Course Outcomes:
After completion of this course the student will be able to

- Define variables and construct expressions.
- Utilize arrays, storing and manipulating data.
- Develop efficient, modular programs using functions.
- Write programs to store and retrieve data using files.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS12	PSO1	PSO2	PSO3
CO1	2	3	2		1				2			2	3	2	2
CO2	2	2	2		1				2			2	2	2	2
CO3	2	3	2		1				2			2	2	2	2
CO4	2	3	2		1				2			2	3	2	2
CO5	2	2	2		1				2			2	2	2	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : September 6, 2021 **ACADEMIC COUNCIL: 21st AC(September 17, 2021)**

SDG No. & Statement: 4 Quality Education

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Learning a programming language like Python students can get decent jobs in different fields.

CSEN1031	ARTIFICIAL INTELLIGENCE APPLICATIONS	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	CSEN1011: Problem Solving and Programming with C CSEN1021: Programming with Python						
Co- requisite	Nil						
Preferable exposure	Programming						

Course Description:

The surge in the production of data has led to the development of various technologies. The term "Artificial Intelligence (AI)" has become ubiquitous in everyday applications from virtual assistants to self-driving cars. Several applications such as Healthcare, Finance, Bioinformatics etc. are benefitting from the advances in the domain. The global market for artificial intelligence is going to face a phenomenal growth over the coming years with organizations across the world capitalizing on the disruptive technologies that AI is offering. This course introduces the recent applications of AI namely, Virtual Assistants, Computer Vision, along with trending topics such as Deep Learning and Reinforcement Learning. The idea of the course is to introduce the basic concepts of AI as well as latest trends in the domain. This course is envisaged to provide a basic understanding on latest developments of AI to all disciplines engineering undergraduates.

Course Educational Objectives:

1. Provide introduction to basic concepts of artificial intelligence.
2. Explore applications of AI
3. Explore the scope, advantages of intelligent systems
4. Experiment with different machine learning concept
5. Exposure to AI-intensive computing and information system framework

UNIT 1 **2 Hours**

Introduction to Artificial intelligence: Basics of AL Agents and Environment, The Nature of Environment.

List of Experiment(s):

Implementation of toy Problems (8-Puzzle, Wumpus World, Vacuum-clean Example, etc)

UNIT 2 **2 Hours**

Applications of AI: Game Playing, [Deep Blue in Chess, IBM Watson in Jeopardy, Google's Deep Mind in AlphaGo]

List of Experiment(s):

1. Implementation of (Sudoku, Crossword Puzzle, or Wumpus World, etc)

UNIT 3 2 Hours

Conceptual introduction to Machine Learning: Supervised, Unsupervised, and Semi-Supervised Learning.

List of Experiment(s):

1. Supervise - Perform Data Labelling for various images using object recognition

UNIT 4 2 Hours

Reinforcement Learning, Introduction to Neural Networks, Deep Learning

List of Experiment(s):

1. Explore the effect of different hyperparameters while implementing a Simple Fully Connected Neural Network. (https://playground.tensorflow.org)

UNIT 5 2 Hours

Image Processing & Computer Vision: Introduction to Image processing, Image Noise, Removal of Noise from Images, Color Enhancement, Edge Detection.

List of Experiment(s):

1. Lobe.ai - Build custom models using the visual tool for Object recognition and sentiment analysis that can convert facial expressions into emoticons

UNIT 6 2 Hours

Segmentation. Feature Detection & Recognition. Classification of images. Face recognition, Deep Learning algorithms for Object detection & Recognition.

List of Experiment(s):

1. Teachable Machine Brain.JS In Browser Object Recognition through
2. Haar Cascade Object detection for Eye and Face in Python using Open CV

UNIT 7 2 Hours

Conceptual introduction to Natural Language Processing: Speech Recognition & Synthesis: Speech Fundamentals, Speech Analysis, Speech Modelling.

List of Experiment(s):

1. Sentiment Analysis and Polarity detection

UNIT 8 2 Hours

Speech Recognition, Speech Synthesis, Text-to-Speech, Sentiment Analysis, Segmentation and recognition.

List of Experiment(s):

1. Text to Speech recognition and Synthesis through APIs

UNIT 9 2 Hours

Introduction to o Chatbot, Architecture of a Chatbot. NLP in the cloud, NL Interface, How to Build a Chatbot, Transformative user experience of chatbots, Designing Elements of a chatbot, Best practices for chatbot development. NLP components. NLP wrapper to chatbots. Audiobots and Musicbots.

List of Experiment(s):

1. Building a Chatbot using IBM Watson visual studio
2. Building a Chatbot using Pandora bots
3. Build a virtual assistant for Wikipedia using Wolfram Alpha and Python

UNIT 10 **2 Hours**

Smart Applications: Smart Manufacturing, Smart Agriculture, Smart Healthcare, Smart Education, Smart Grids, Smart Transportation and Autonomous Vehicles, Smart Homes, Smart Cities

List of Experiment(s):

1. Build a smart application specific to the domain of the student.

Textbooks:

1. Tom Markiewicz& Josh Zheng, Getting started with Artificial intelligence, Published by O'Reilly Media,20l7
2. Stuart J. Russell and Peter Norvig, Artificial Intelligence A Modern Approach.

References:

1. Aurtlien Giron. Hands on Machine Learning with Scikit-Learn and TensorFlow concepts,Tools, and Techniques to Build intelligent Systems , Published by O'Reilly Mcdia,20l 7
2. Build an AI Assistant with wolfram alpha and Wikipedia in python.https://medium .com/@salisuwy/build-an-ai-assistant-with-wolfram-alpha-and-wikipedia-in-python-d9bc8ac838fe.
3. Joseph Howse, Prateek Joshi, Michael Beyeler - Opencv Computer Vision Projects withPython-Publishing (201 6).
4. Curated datasets on kaggle https://www.kaggle.com/datasets.

Course Outcomes:

1. Able to grasp the concepts of artificial intelligence, machine learning, natural language processing, image processing
2. Recognize various domains in which Al can be applied
3. Implement the methods in processing an image:
4. Implement simple of chatbots
5. identify smart applications:

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2		1				2			2	3	2	2
CO2	2	2	2		1				2			2	2	2	2
CO3	2	3	2		1				2			2	2	2	2
CO4	2	3	2		1				2			2	3	2	2
CO5	2	2	2		1				2			2	2	2	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : September 6, 2021

ACADEMIC COUNCIL: 21st AC(September 17, 2021)

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE1001</td><td rowspan="2">BASIC ELECTRICAL AND ELECTRONICS ENGINEERING</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>1</td><td>2</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">Nil</td></tr>
<tr><td>Co- requisite</td><td colspan="7">Nil</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Nil</td></tr>
</table>

Course Description:

This course introduces the fundamental principles and building blocks of electrical and electronics engineering. The first three units cover the electric circuit laws, theorems, and principles of electrical machines. The last two units cover semiconductor devices and their applications.

Course Educational Objectives:

1. To impart the analysis and design aspects of DC networks in electrical and electronic circuits
2. To explain the basic concepts of AC networks used in electrical and electronic circuits.
3. To demonstrate the importance and operating principles of electrical machines (transformers, motors and generators)
4. To impart the knowledge about the characteristics, working principles and applications of semiconductor diodes, Metal Oxide Semiconductor Field Effect Transistors (MOSFETs).
5. To expose basic concepts and applications of Operational Amplifier and configurations.

UNIT 1 **7 Hours**

DC Circuits: Basic circuit elements and sources, Ohms law, Kirchhoff's laws, series and parallel connection of circuit elements, Node voltage analysis, Mesh current analysis, Superposition, Thevenin's and maximum power transfer theorem.

UNIT 2 **8 Hours**

AC Circuits: Alternating voltages and currents, AC values, single phase RL, RC, RLC series circuits, power in AC circuits, Power Factor, three phase systems-Star and Delta Connection-Three phase power measurement.

UNIT 3 **9 Hours**

Electrical Machines: Construction, working principle and application of DC machines, Transformers, single phase and three phase Induction motors, special machines-Stepper motor, Servo motor and BLDC motor.

UNIT 4 **8 Hours**

Semiconductor Devices: p-n Junction diode - Basic operating principle, current-voltage characteristics, rectifier circuits (half-wave, full-wave, rectifier with filter capacitor), Zener diode as Voltage Regulator; Metal oxide semiconductor field effect transistor (MOSFET): Operation of NMOS and PMOS FETs, MOSFET as an amplifier and switch.

UNIT 5 **8 Hours**

Operational Amplifiers: The Ideal Op-amp, The Inverting Configuration, The closed loop gain, Effect of Finite open-loop gain, The Noninverting Configuration, The closed loop gain, Characteristics of Non-Inverting Configuration, Difference amplifiers, A Single Op-amp difference amplifier. Adders, subtractors, integrators, differentiators, filter circuits using Opamps,

Basic Electrical and Electronics Engineering Laboratory

List of Experiments:

1. Verification of Kirchhoff's Laws.
2. Verification of DC Superposition Theorem.
3. Verification of Thevenin's Theorem.
4. Verification of Maximum power transfer Theorem.
5. Load test on DC generator.
6. Load test on single phase transformer.
7. Measurement of voltage, current and power factor of single phase RL, RC series circuits.
8. Measurement of voltage, current and power factor of single phase RLC series circuit.
9. Measurement of power in a three phase circuit.
10. Current Voltage Characteristics of a p-n Junction Diode/LED.
11. Diode Rectifier Circuits.
12. Voltage Regulation with Zener Diodes.
13. Design of a MOSTFET amplifier and MOSFET inverter/NOR gate
14. Inverting and Non-inverting Amplifier Design with Op-amps.
15. Simulation experiments using PSPICE
    a) Diode and Transistor Circuit Analysis.
    b) MOSFET Amplifier design.
    c) Inverting and Noninverting Amplifier Design with Op-amps.

Textbooks:

1. D. P. Kothari, I. J. Nagrath, Basic Electrical and Electronics Engineering, 1/e, McGraw Hill Education (India) Private Limited, 2017.
2. B. L. Theraja, Fundamentals of Electrical Engineering and Electronics, 1/e, S. Chand Publishing, New Delhi, 2006.
3. Adel S. Sedra and Kenneth C. Smith, Microelectronic Circuits 6/e, Oxford University Press, 2014.

References:

1. S.K. Bhattacharya, Basic Electrical and Electronics Engineering, Pearson Education,

2011.
2. Dharma Raj Cheruku, B T Krishna, Electronic Devices and Circuits, 2/e, Pearson Education, 2008.
3. R. K. Rajput, Basic Electrical and Electronics Engineering, University Science Press, New Delhi, 2012.

Course Outcomes:

After completion of this course, the student will be able to

1. predict and analyse the behaviour of an electrical circuit (L3).
2. analyse the performance quantities such as losses, efficiency and identify applications of DC machines (L4).
3. explain the use of transformers in transmission and distribution of electric power and other applications (L2).
4. demonstrate the operation and applications of various electronic devices (L2).
5. construct Inverting and Noninverting configurations of Op-amp (L3).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:
SDG3: Good Health and Well Being: Understanding the fundamentals of electrical and electronics systems can help in designing systems, to promote good health and well being

SDG5: Gender Equality: Acquiring the interdisciplinary knowledge help overcome the gender barriers in workplace

SDG8: Descent Work and Economic: The learners of this course can get descent work and earn financial benefits and they can work in interdisciplinary areas

SDG12: Responsible Consumption and Production: Use of right and energy efficient electric and electronic components and devices results in reasonable consumption and production
SDG Justification:

<table>
<tr><td rowspan="2">HSMCH102</td><td rowspan="2">UNIVERSAL HUMAN VALUES 2:
UNDERSTANDING HARMONY</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">Nil</td></tr>
<tr><td>Co- requisite</td><td colspan="7">Nil</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Nil</td></tr>
</table>

Course Description:

During the Induction Program, students would get an initial exposure to human values through Universal Human Values – I. This exposure is to be augmented by this compulsory full semester foundation course.

Course Educational Objectives:

The objective of the course is fourfold:

1. Development of a holistic perspective based on self- exploration about themselves (human being), family, society, and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society, and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

COURSE TOPICS: The course has 28 lectures and 14 practice sessions in 5 modules:

UNIT 1 Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I.
2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration.
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority.
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

UNIT 2 Understanding Harmony in the Human Being - Harmony in Myself!

1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'.
2. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility.
3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer).
4. Understanding the characteristics and activities of 'I' and harmony in 'I'.
5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.
6. Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available tome. Identifying from one's own life.
Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

UNIT 3 Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

1. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
2. Understanding the meaning of Trust; Difference between intention and competence
3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
4. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
5. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

UNIT 4 Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

1. Understanding the harmony in the Nature
2. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature.
3. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space.

4. Holistic perception of harmony at all levels of existence.
5. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

UNIT 5 Implications of the above Holistic Understanding of Harmony on Professional Ethics

1. Natural acceptance of human values
2. Definitiveness of Ethical Human Conduct
3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
4. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
5. Case studies of typical holistic technologies, management models and production systems
6. Strategy for transition from the present state to Universal Human Order:
    a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers
    b. At the level of society: as mutually enriching institutions and organizations
7. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions e.g. To discuss the conduct as an engineer or scientist etc.

Text Books:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

References:

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)

13. Gandhi - Romain Rolland (English)

Lectures hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them. Tutorial hours are to be used for practice sessions.

While analysing and discussing the topic, the faculty mentor’s role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.

In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one’s own self and do self- observation, self-reflection and self-exploration.

Scenarios may be used to initiate discussion. The student is encouraged to take up “ordinary” situations rather than” extra-ordinary” situations.

Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions (tutorials)would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.

It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses.

This course is to be taught by faculty from every teaching department, including HSS faculty.

Teacher preparation with a minimum exposure to at least one 8- day FDP on Universal Human Values is deemed essential.

ASSESSMENT:
This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self-assessment, peer assessment etc. will be used in evaluation.

Example:
Assessment by faculty mentor: 10 marks
Self-assessment: 10 marks
Assessment by peers: 10 marks
Socially relevant project/Group Activities/Assignments: 20 marks Semester End Examination:

50 marks
The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.

Course Outcomes:
By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to- day settings in real life, at least a beginning would be made in this direction.

This is only an introductory foundational input. It would be desirable to follow it up by
  a. faculty-student or mentor-mentee programs throughout their time with the institution
  b. Higher level courses on human values in every aspect of living. E.g. as a professional

INTN2333	INTERNSHIP 1	L	T	P	S	J	C
		0	0	0	0	1	1
Pre-requisite	Completion of minimum of four semesters						
Co- requisite							
Preferable exposure							

Course Educational Objectives:

1. The course is designed to expose the students to expected industry skills and industry environment and to take up onsite assignment as trainees or interns.

Contents: **1 Week**

One week of work at industry site. Supervised by an expert at the industry.

Mode of Evaluation: Internship Report, Presentation and Project Review

Course Outcomes:

At the end of this internship the student should be able to:

1. Have an exposure to industrial practices and to work in teams
2. identify skill set required to participate activity in real-time projects relevant to the industry
3. Understand the impact of engineering solutions in a global, economic, environmental and societal context
4. formulate technical background required to participate in Internship 2

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

INTN3444	INTERNSHIP 2	L	T	P	S	J	C
		0	0	0	0	1	3
Pre-requisite	Completion of minimum of six semesters						
Co- requisite							
Preferable exposure							

Course Educational Objectives:

1. The course is designed to expose the students to industry environment and to take up onsite assignment as trainees or interns.

Contents: **1 Week**

Four weeks of work at industry site. Supervised by an expert at the industry

Mode of Evaluation: Internship Report, Presentation and Project Review

Course Outcomes:

At the end of this internship the student should be able to:

1. Have an exposure to industrial practices and to work in teams
2. Communicate effectively
3. Understand the impact of engineering solutions in a global, economic, environmental and societal context
4. Develop the ability to engage in research and to involve in life-long learning
5. Comprehend contemporary issues
6. Engage in establishing his/her digital footprint

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

MATH1001	SINGLE VARIABLE CALCULUS	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	**NIL**						
Co- requisite	**NIL**						
Preferable exposure	**NIL**						

Course Description:

This course is designed to impart knowledge on differentiation and integration of function, emphasizing their inter-relationship and applications to engineering.

Course Educational Objectives:

1. To familiarize the students in the concepts the derivatives and its underlying concepts like limits and continuity.
2. To explain the concept of derivative and calculation of extreme values of extreme values of various functions.
3. To impart knowledge on integration for the computation of areas, arc lengths.
4. To demonstrate various techniques of integrations.

UNIT 1 Limits and continuity of single and several variables 6 Hours

Limit of a Function and Limit Laws, The Precise Definition of a Limit, One-Sided Limits, Continuity (Without proofs). Functions of Several Variables, Limits and Continuity in Higher Dimensions (Without proofs)

UNIT 2 Derivatives and applications 7 Hours

The Derivative as a Function, Differentiation Rules, The Chain Rule, Extreme Values of Functions on Closed Intervals, Monotonic Functions (Without proofs)

UNIT 3 Integrals and applications 7 Hours

The Definite Integral, The Fundamental Theorem of Calculus, Indefinite Integrals and the Substitution Method, Definite Integral Substitutions and the Area between Curves, Arc Length (Without proofs)

UNIT 4 Techniques of integration 6 Hours

Using basic Integration Formulas, Integration by Parts, Trigonometric Integrals, Trigonometric Substitutions, Integration of Rational Functions by Partial Fractions (Without proofs)

Textbooks:

1. Joel Hass, Christopher Heil, Maurice D. Weir, Thomas' Calculus, Fourteenth edition, Pearson Addison Wesley (2018).

References:

1. Erwin Kreyszig, Advanced Engineering Mathematics,10/e, John Wiley & Sons, 2018.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.
3. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015.
4. Hyghes-Hallett, Gleason, McCallum et al. Single Variable Calculus (6th Edn) John Wiley and Sons New York, 2013.

Course Outcomes:

At the end of the course, the student will be able to

- determine limit, one sided limit, continuity of single and several variable functions.
- solve problems in a range of mathematical applications using differentiation
- solve problems in a range of mathematical applications using integration
- apply the fundamental theorem of calculus.
- evaluate integrals using various techniques.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusion and equitable quality education and promote lifelong opportunities for all

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH1011	SEVERAL VARIABLE CALCULUS	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	MATH1001						
Co- requisite	NIL						
Preferable exposure	Engineering and Science						

Course Description:

This course is designed to impart knowledge on calculus of functions of more variables which are useful in modelling and analyzing physical phenomena involving continuous change of variables or parameters and have applications across all branches of engineering.

Course Educational Objectives:

1. To teach basic concepts of partial derivatives.
2. To explain the evaluation of double integrals and its applications.
3. To demonstrate the evaluation and applications of triple integrals.
4. To acquaint the knowledge of line and surface integrals and applications.

UNIT 1 Partial derivatives and applications 7 Hours

Partial Derivatives of a Function of Two Variables and More Than Two Variables, Second-order Partial derivatives, The Chain Rule for Functions of Two and Three variables, Extreme Values and Saddle Points, Lagrange Multipliers, Taylor's Formula for Two Variables (Without proofs)

UNIT 2 Double integrals 6 Hours

Double and iterated Integrals over Rectangles, Double Integrals over General Regions, Area by Double Integration: Area of bounded region in a plane, Double Integrals in Polar Form. (Without proofs)

UNIT 3 Triple integrals 5 Hours

Triple Integrals in Rectangular Coordinates: Triple Integrals, Volume of a Region in Space, Finding limits of integration, Triple Integrals in Cylindrical and Spherical Coordinates. (Without proofs)

UNIT 4 Integrals and Vector fields 8 Hours

Vector Fields and Line Integrals: Line Integrals of Vector Fields, Line Integrals with Respect to dx, dy, or dz, Work Done by a Force over a Curve in Space, Green's Theorem in the Plane: Tangential form, Using Green's Theorem to Evaluate the Line Integral and Verification, Surface Integrals: Surface Integrals of Vector Fields, Stokes' Theorem (Without proofs)

Textbooks:

1. Joel Hass, Christopher Heil, Maurice D. Weir, Thomas' Calculus, Fourteenth edition,

Pearson Addison Wesley (2018).

References:

1. Erwin Kreyszig, Advanced Engineering Mathematics,10/e, John Wiley & Sons, 2018.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.
3. Hyghes-Hallett, Gleason, McCallum et al. Multivariable Variable Calculus (6th Edn) John Wiley and Sons New York, 2013.
4. James Stewart. Multivariate Calculus, Concepts and Contexts. (3rd Edn) Thomson/Brooks/Cole, Canada, 2005.

Course Outcomes:

At the end of the course, the student will be able to

- utilize functions of several variables in optimization.
- employ the tools of calculus for calculating the areas.
- calculate volumes using multiple integrals.
- determine the work done using vector calculus
- determine the rate of flow of a fluid using vector calculus

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusion and equitable quality education and promote lifelong opportunities for all

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

<table>
<tr><td rowspan="2">MATH2371</td><td rowspan="2">DIFFERENCE EQUATIONS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Co- requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Engineering and Science</td></tr>
</table>

Course Description:

Difference equations is the study of equation which involves the difference of a discrete function. In this course, the student can form a difference equation, solving linear higher order difference equations using analytical techniques, simultaneous linear difference equations and also find the solution of linear higher order difference equations and simultaneous difference equations using Z-transforms.

Course Educational Objectives:

1. Student is able to know how to find the order of a difference equation and complementary function of a difference equation.
2. Student is able to know how to find the particular solution of a difference equation and also find the solutions of simultaneous linear difference equations.
3. Student is able to know how to find Z-transforms a discrete function using properties and using to basic theorems.
4. Student is able to know how to find the inverse Z-transforms a function and also using convolution theorem.
5. Student is able to know how to find the solution of a difference equation using Z-transforms

UNIT 1 **Difference equations - I** **5 Hours**

Introduction, definition of order, and solution of difference equation, formation of difference equations, linear difference equations, complementary function, rule for finding complementary function.

UNIT 2 **Difference equations-II** **5 Hours**

Particular integrals, Rule for finding particular integrals, simultaneous linear difference equations.

UNIT 3 **Z-transforms** **5 Hours**

Introduction, Definition, some standard Z-transforms, linear property, damping rule, Shifting U_n to the **right and to the left, Multiplication by n, two basic theorems.**

UNIT 4 **Inverse Z-transforms** **5 Hours**

Convergence of Z-transforms, evaluation of inverse Z-transforms, properties, convolution theorem.

UNIT 5 Applications of Z-transforms 5 Hours

Solving difference equations and simultaneous linear difference equations with constant coefficients by Z-transforms.

Textbooks:

1. “Higher Engineering Mathematics” by B.S. Grewal published by Khanna Publishers

References:

1. Advanced Engineering mathematics by Irvin Kreyszig

Course Outcomes:

1. Able to find the order of a difference equation and complementary function of a difference equation.
2. Able to find the particular solution of a difference equation and also find the solutions of simultaneous linear difference equations.
3. Able to find Z-transforms a discrete function using properties and using to basic theorems.
4. Able to find the inverse Z-transforms a function and also using convolution theorem.
5. Able to find the solution of a difference equation using Z-transforms

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH1031	DIFFERENTIAL EQUATIONS	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	**NIL**						
Co- requisite	**NIL**						
Preferable exposure	**Engineering and Science**						

Course Description:

This course is designed to impact the knowledge on ordinary, partial differential equations and their applications.

Course Educational Objectives:

6. To familiarize the students with the basic concepts of ordinary differential equations.
7. To demonstrate the evaluation and applications of first order differential equations.
8. To explain the evaluations of linear homogeneous and non-homogeneous differential equations.
9. To familiarize the students with the basic concepts of partial differential equations.
10. To explain the concepts of first order partial differential equations.
11. To demonstrate the evaluation of differential equations using math software's

UNIT 1 First Order Ordinary Differential Equations 5 Hours

Order and Degree of an Ordinary Differential Equation (ODE), ODE's of first order and first degree, Variable separable method, Linear Equations, Bernoulli's Equations.

UNIT 2 Linear Ordinary Differential Equations of High Order 6 Hours

Definitions, Complete Solution, Operator D, Complimentary function, Inverse operator, Rules for finding particular integral (e^{ax}, sinbx/cosbx, x^m& $e^{ax}v(x)$)

UNIT 3 Applications of Linear Ordinary Differential Equations of Higher Order 5 Hours

Method of Variation of Parameters, Simple Harmonic Motion, Oscillations of a Spring

UNIT 4 Introduction to Partial Differential Equations 5 Hours

Introduction, Formation of Partial Differential Equation(PDE), Solutions of a PDE, Equations solvable by direct integration, Linear equations of the first order.

UNIT 5 Partial Differential Equations of Second Order 5 Hours

Homogeneous linear equations with constant coefficients, Rules for finding the complementary function and particular integral, Working procedure to solve the equations.

Textbooks:

1. Simmons, G.F., Differential Equations with Applications and Historical Notes, Second Edition, McGraw-Hill, Inc., 1991.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.

References:

1. Shepley L. Ross, *Differential Equations*, 3rd Ed., John Wiley and Sons, 1984
2. Sneddon, *Elements of Partial Differential Equations*, McGraw-Hill, International Edition, 1967.
3. Erwin Kreyszig, Advanced Engineering Mathematics,10/e, John Wiley & Sons, 2018.

Course Outcomes:

1. Form and find the solution of an ordinary differential equation.
2. Apply the concept of differential equations to solve real world problems.
3. Evaluate linear homogeneous and non homogeneous differential equations
4. Form and find the solution of a partial differential equations of first order.
5. Evaluate second order partial differential equations and solution of differential equations using computational tool.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4
Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:
Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

<table>
<tr><td rowspan="2">MATH2281</td><td rowspan="2">NUMERICAL TECHNIQUES</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Co- requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Engineering and Science</td></tr>
</table>

Course Description:

This course is designed to enhance problem solving skills of engineering students using a powerful problem-solving tool namely numerical Techniques. The tool is capable of handling large systems of equations, nonlinearities and complicated geometries that are common in engineering practice but often impossible to solve analytically.

Course Educational Objectives:

1. To familiarize the students with numerical solutions of nonlinear and systems of linear equations.
2. To get exposed to finite differences and interpolation.
3. To demonstrate the numerical differentiation and integration.
4. To explain the numerical solutions of ordinary differential equations

UNIT 1 Solution of algebraic and transcendental equations 6 Hours

Regula-falsi method and Newton- Raphson method. **Solution of linear system of equations**-Iterative methods: Gauss Jacobi method, Gauss Seidel method, and finding the eigenvalues of a matrix by Power method.

UNIT 2 Interpolation 5 Hours

Difference operators (shifting, delta, del) and difference tables, Newton's forward and backward interpolation formulae, Divided difference formula, and Lagrange's interpolation formula.

UNIT 3 Numerical Differentiation and Numerical Integration 5 Hours

Numerical Differentiation: Derivatives using forward, and backward difference formulae.
Numerical Integration: Trapezoidal rule, Simpson's 1/3rd rule, Simpson's 3/8th rules.

UNIT 4 Numerical solutions of ordinary differential equations - 1 5 Hours

Picard's method, Taylor's series method, Euler's method, and Modified Euler's method

UNIT 5 Numerical solutions of ordinary differential equations - 2 5 Hours

Runge-Kutta method (second and fourth order), Predictor-Corrector methods-Adams-Bashforth and Milne's methods.

Text Books:

1. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2018.

References:

1. M.K. Jain, S.R.K. Iyengar, R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 5/e, New Age International(P) Limited, 2007.
2. S.S. Sastry, Introductory methods of Numerical Analysis,4/e,PHI Learning Publications,2009.
3. H.C Saxena, Finite Differences and Numerical Analysis, Chand and Company Pvt. Ltd., New Delhi.

Course Outcomes:

At the end of the course, the student will be able to

1. analyze how root finding techniques can be used to solve practical engineering problems.
2. apply various interpolation techniques to solve practical problems .
3. apply numerical differentiation and integration whenever and wherever routine methods are not applicable .
4. solve differential equations using various numerical methods .
5. know the strengths and weaknesses of the various methods and be able to decide which ones are appropriate for a particular problem

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH1021	TRANSFORM TECHNIQUES	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	MATH1031						
Co- requisite	NIL						
Preferable exposure	Engineering and Science						

Course Description:

This course is designed to impact the knowledge on (Laplace, Fourier) transforms and applications of these transforms on differential equations.

Course Educational Objectives:

1. To introduce and explain the concepts of Laplace transforms and properties.
2. To demonstrate the evaluation of Laplace transforms of special functions and additional properties.
3. To impart knowledge on obtaining Fourier series
4. To introduce and explain the concepts of Fourier transforms and properties.
5. To explain the evaluation of Fourier transforms of various function and then applications to boundary value problem.
6. To demonstrate and understand the transform techniques using available software

UNIT 1 Laplace transforms 5 Hours

Introduction, transforms of elementary functions, properties of Laplace transforms, transforms of derivatives, transforms of Integrals, Multiplication by t^n, Division by t.

UNIT 2 Applications of Laplace transforms 5 Hours

Evaluation of integrals by Laplace transforms, Inverse transforms, Solution of Differential equations.

UNIT 3 Fourier Series 6 Hours

Introduction, Conditions for a Fourier expansion, Functions having points of discontinuity, Change of interval.

UNIT 4 Half-Range Fourier Series 3 Hours

Even and odd functions, Half range sine series, and Half range cosine series.

UNIT 5 Fourier transforms 7 Hours

Introduction, Fourier sine & cosine integrals, Fourier transforms, Properties of Fourier transforms-linear, change of scale & shifting property.

Text Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2018.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.

References:

1. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002.
2. George B. Thomas, Maurice D. Weir and Joel R. Hass, Thomas' Calculus, 13/e, Pearson Publishers, 2014.
3. Glyn James, Advanced Modern Engineering Mathematics, 4/e, Pearson Publishers, 2011.

Course Outcomes:

At the end of the course students will be able to

1. find Laplace transform of a function along with properties.
2. evaluate the Laplace transform of special functions.
3. apply the Laplace transform for solving differential equations (continuous systems)
4. evaluate the Fourier transform of a function along with properties and solve boundary value problems by Fourier transforms.
5. evaluate the engineering problems using transform techniques with the help of advanced math software

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH2381	OPERATIONS RESEARCH	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	**NIL**						
Co- requisite	**NIL**						
Preferable exposure	**Engineering and Science**						

Course Description:

Operations Research (OR), also known as management science, has become an indispensable tool in scientific management. Operations Research focuses on developing and analyzing strategic and tactical levels to aid in decision-making and decision-making on the operational level. The essential tools of OR are algorithms, procedures that create and improve solutions to a point at which optimal or, at least, satisfactory solutions have been found.

Course Educational Objectives:

This course is designed to:

1. introduce the fundamentals of Operations Research to the students at the undergraduate level
2. solve different types of optimization problems of various categories and applying modern methodologies in the area of optimization
3. help students to develop a deep understanding of the classical and numerical optimization techniques and problem-solving capabilities

UNIT 1 — Linear Programming — 4 Hours

Formulation of LPP, convex sets and their properties, slack and surplus variables, Basic solution, Basic feasible solution, non-degenerate and degenerate basic feasible solutions, optimal solution, General, Standard, and Canonical form of LPP.

UNIT 2 — Simplex Method — 8 Hours

Simplex method, Degeneracy in LPP, Artificial variables techniques-Two Phase method, Big M-method.

UNIT 3 — Duality — 5 Hours

Duality in linear programming, primal-dual relationships, weak duality theorem, strong duality theorem, and dual simplex method.

UNIT 4 — Integer Programming — 4 Hours

Gomory’s cutting plane method, Branch and Bound method for solving integer linear programming problems

UNIT 5 — Sensitivity Analysis — 5 Hours

Introduction to sensitivity analysis, variations in the price vector, variations in the requirement vector, addition of a new decision variable to the existing problem.

Textbooks:

1. Operations Research by S.D.Sarma, Kedarnath, Ramnath and company, 15th edition, 2008.
2. Operations Research An Introduction by Hamdy A. Taha, 8th edition, Pearson, 2007.

References:

1. Linear Programming by R K Gupta, Krishna Prakashan Mandir, 13th edition 2014.
2. Operations Research Theory and Applications by J K Sharma, 4th edition, Macmillan Publishers India Ltd, 2009

Course Outcomes:

On successful completion of this course, students will be able to:

1. understand the linear programming problem, its formation, and basic definitions of solutions
2. understand the simplex method, which is a very efficient algorithm to solve a linear programming problem
3. understand the dual primal relationship, properties of duality, and the dual simplex algorithm
4. find integer solutions to LPP by cutting plane methods
5. find variations in price and requirement vectors and retaining optimality

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH2301	COMPLEX VARIABLES	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	NIL						
Co- requisite	NIL						
Preferable exposure	Engineering and Science						

Course Description:

This course is designed to familiarize the students with complex analysis, nature of a series, evaluation of integrals using Cauchy's theorem.

Course Educational Objectives:

- To explain the concept of complex functions and analytic functions.
- To explain the concept of conformal mapping.
- To explain the concept of Cauchy's theorem and residue theorem.
- To explain the convergence of series such as Taylor's and Laurent.
- To explain the concept of Cauchy's theorem and residue theorem.

UNIT 1 **Functions of a Complex variable** **6 Hours**

Limit and continuity, Differentiation, Analytic functions, Cauchy-Riemann equations, harmonic functions, finding harmonic conjugates- applications to flow problems.

UNIT 2 **5 Hours**

Geometrical representation of f(z) – Some standard transformations – Bilinear transformation - Conformal mappings. Special conformal transformations ($w = z^2$, $w= z+1/z$, $w = e^z$, w= coshz)

UNIT 3 **Complex Integration** **5 Hours**

Integration of complex functions - Cauchy's theorem - Cauchy's integral formula.

UNIT 4 **Series representation of analytic functions** **5 Hours**

convergent series of analytic functions, Laurent 's and Taylor series, zeros and singularities of an analytic function

UNIT 5 **Calculus of residues** **5 Hours**

Residue -Cauchy Residue theorem – Calculation of residues (All theorems without proof).

Text Books:

1. B.S.Grewal, Higher Engineering Mathematics, 42nd Edition, Khanna Publishers, New Delhi, 2012.

References:

1. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics Narosa Publishing House, New Delhi, 2014.
2. N. P. Bali and Manish Goyal, A Text Book of Engineering Mathematics, 8th Edition, Lakshmi Publications, New Delhi, 2012.

Course Outcomes:

1. Make use of differentiation and integration of complex functions in engineering problems.
2. Concept of conformal mappings .
3. Use Cauchy's theorem and Cauchy's integral formula to evaluate the line integrals
4. Apply Taylor's and Laurent's series to expand complex functions and know about the convergence region .
5. Evaluation of integrals using Residue theorem.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4
Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:
Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

<table>
<tr><td rowspan="2">MATH1041</td><td rowspan="2">DISCRETE MATHEMATICS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Co- requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Engineering and Science</td></tr>
</table>

Course Description:

Discrete Mathematics introduces students to the mathematics of networks, social choice, and decision making. This course provides students with a hands-on exploration of the relevancy of mathematics in the real world. This course reflects the rigor taught in many entry-level mathematics courses.

Course Educational Objectives:

1. To introduce basics of mathematical logical operators and connectives
2. To impart knowledge on normal forms and rules of inference.
3. To impart knowledge on partially ordered and total ordered sets.
4. To familiarize closed form solution of linear recurrence relations by various methods.
5. To impart knowledge on basic concepts of algebraic structures.
6. To write program structures, and understand when programming is most applicable

UNIT 1 Logic Operators and Connectives 5 Hours

Negation, conjunction, disjunction, conditional and bi-conditional, well formed formulae, tautologies, equivalence of formulae, duality, tautological implications.

UNIT 2 Mathematical logic 5 Hours

Conjunctive and disjunctive normal forms- principal disjunctive and conjunctive normal forms, Rules of inference for propositional calculus (Rule P, Rule T and CP rule).

UNIT 3 Sets and Relations 5 Hours

Basic concepts of set theory, Power set, relations, properties of binary relations in a set, Equivalence relations, composition of binary relations, Partial ordering, Partially ordered set.Hasse diagram.

UNIT 4 Recurrence relations 5 Hours

Recurrence relations, solving linear recurrence relations by characteristic roots method, system of recurrence relations.

UNIT 5 Algebraic Structures 6 Hours

Algebraic Structures-Semi group, Monoid, Groups, subgroups, cosets (definition and examples) Lagrange's theorem on finite groups

Text Books:

1. J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw Hill, 1997.
2. Kenneth H. Rosen, Discrete Mathematics and Applications, Seventh edition, Tata McGrawHill,2012.

References:

1. Bhishma Rao, Mathematical Foundations of Computer Science, SciTech Publications (India) Pvt Ltd.
2. Discrete Mathematical Structures,Sixth edition-Kolman,Busby,Ross

Course Outcomes:

Upon successful completion of this course the student should be able to

1. Check the validity of a statement formula
2. analyze the concepts in set theory and relations
3. find a general solution of recurrence equation
4. build the algebraic structures and apply Lagrange's theorem on finite groups
5. Convert problem solving strategies to procedural algorithms

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4
Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:
Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH1051	Graph Theory	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	NIL						
Co- requisite	NIL						
Preferable exposure	Engineering and Science						

Course Description:

This course introduces basic concepts in Graph Theory, including properties and characterization of graph/trees and graph theoretic algorithms, which are widely used in Mathematical modelling and has got applications across Computer Science and other branches in Engineering.

Course Educational Objectives:

1. To introduce basics of group theory and its applications
2. To impart knowledge on basic concepts of paths and circuits
3. To impart knowledge on Trees, spanning trees, shortest spanning trees
4. To familiarize in the matrix representation of graphs
5. To transform scientific problems into generic computational models

UNIT 1 Basics of graphs 5 Hours

Finite and Infinite Graphs, Incidence and Degree, Isolated Vertex, Pendant Vertex, and Null Graph, complete graph, Bi-partite and complete Bi-partite graphs.

UNIT 2 Matrix representation of graphs 5 Hours

Adjacency Matrix, Incidence Matrix, Path Matrix (Definition and examples)

UNIT 3 Paths and circuits 6 Hours

Paths, and Circuits, Connected Graphs, Disconnected Graphs, and Components, Euler Graphs, Hamiltonian graphs (Definition, examples and without proofs)

UNIT 4 Trees 5 Hours

Trees and their properties, spanning trees, minimal spanning trees, Kruskal's algorithm for finding a minimal spanning tree.

UNIT 5 Applications of Trees and Fundamental circuits 5 Hours

Preorder, in order and post order traversals, Prefix and Postfix notations of an arithmetic expression, parsing trees.

Textbooks:

1. J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw Hill, 1997.

2. Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science, Prentice Hall of India, 2006.

References:

1. Bhishma Rao, Mathematical Foundations of Computer Science, SciTech Publications (India) Pvt Ltd.
2. Kenneth H. Rosen, Discrete Mathematics and Applications, Seventh edition, Tata McGrawHill,2012.

Course Outcomes:

Upon successful completion of this course the student should be able to

1. analyse the concepts in graph theory
2. apply graph theory concepts in core subjects such as data structures and network theory effectively
3. Identify different types of paths
4. Construct minimum spanning tree using some algorithms and identify tree traversals
5. Solve the graphical problems which are accessed in available software

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4
Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:
Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH2311	NUMBER THEORY	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	**NIL**						
Co- requisite	**NIL**						
Preferable exposure	**Engineering and Science**						

Course Description:

This course is designed to explain the basics and applications of number theory for the students of Computer Science. The core courses of these branches encounter with concepts like prime factorization, modular arithmetic, and quadratic reciprocities in number theory. The first unit of the course provide a strong platform for such encounters and the other units focuses on applications of number theory.

Course Educational Objectives:

1. To teach basic concepts of number theory focusing on Computational aspects.
2. To teach the concepts of factorization of integers.
3. To teach Format’s theorem and quadratic residues.
4. To explain Chines remainder theorem and Euclidean algorithm.
5. To explain polynomial arithmetic.

UNIT 1 **Basic Concepts in Number Theory** **5 Hours**

Topics in elementary number theory, Divisibility, Greatest Common Divisor, Euclidean Algorithm

UNIT 2 **5 Hours**

Fundamental theorem of Arithmetic, Congruences, Properties of congruences, Linear congruences

UNIT 3 **5 Hours**

Fermat's theorem, Fermat's little theorem, Wilson’s theorem

UNIT 4 **5 Hours**

Chinese remainder theorem, The functions $\tau\ and\ \sigma$, Euler Phi-function, Euler’s theorem, Some properties of phi function

UNIT 5 **5 Hours**

The order of integer modulo n, Primitive roots for prime, Composite number having primitive roots

Textbooks:

1. Elementary Number Theory | 7th Edition by David Burton, Mc Graw Hill Education

References:

1. Basic Number Theory by S.B. Malik,S. Chand publishers

Course Outcomes:

Upon successful completion of this course the student should be able to

1. Apply concepts of number theory focusing on Computational aspects.
2. Analyze concepts of factorization of integers.
3. Explain Fermat's theorem and quadratic residues.
4. Analyse Chines remainder theorem and Euclidean algorithm.
5. Analyse the concept of polynomial arithmetic.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4
Ensure inclusive and equitable quality education and promote lifelong opportunities for all.
SDG Justification:
Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

<table>
<tr><td rowspan="2">MATH2291</td><td rowspan="2">LINEAR ALGEBRA</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Co- requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Engineering and Science</td></tr>
</table>

Course Description:

This course is designed to gain knowledge in the concepts of Linear Algebra focusing on basics of matrices, vector spaces and singular value decomposition to understand the basic concepts of Linear Algebra in the applications of image processing and machine learning.

Course Educational Objectives:

1. To familiarize with theory of matrices and tools for solving system of linear equations
2. To impart knowledge on Eigen values and Eigen vectors.
3. To teach basic concepts of vector spaces and their properties.
4. To explain the concepts of inner product spaces.
5. To familiarize with concept of singular value decomposition and its applications

UNIT 1 **Fundamentals of Matrices** **5 Hours**

Introduction to Matrices and Rank of a matrix, Echelon form, solving system of linear equations.

UNIT 2 **Eigen values and Eigen vectors** **5 Hours**

Eigen values and Eigen vectors, positive definite matrices, Linear dependence, and Linear independence.

UNIT 3 **Vector Spaces** **6 Hours**

Vector space, linear combination of vectors, linear span, basis and dimension, linear Transformation.

UNIT 4 **Inner Product Spaces** **5 Hours**

Inner Product Spaces, examples of inner product spaces, norm and length of a vector cauchy-schwarz's inequality.

UNIT 5 **Singular value decomposition** **5 Hours**

Singular values, computing singular value decomposition and Introduction to principal component analysis.

Textbooks:

1. Higher Engineering Mathematics, B. S. Grewal.
2. Linear Algebra, Schaum's Outline,4th edition, Seymour Lipchutz,Marc Lipson

References:

1. Advanced Engineering Mathematics, 7th Edition, Peter V. O'Neil.
2. Advanced Engineering Mathematics, 2nd Edition, Michael. D. Greenberg.
3. Introduction to linear algebra, 5th Edition, Gilbert Strang.
4. Applied Mathematics (Vol. I & II), by P. N. Wartikar& J. N. Wartikar.
5. Digital Image Processing, R C Gonzalez and R E Woods.

Course Outcomes:

At the end of the course the student will be able to

- solve the system of linear equations
- calculate Eigen values and Eigen vectors
- find the basis
- learn Singular value decomposition
- learn principal Component analysis

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems.

<table>
<tr><td rowspan="2">MATH2341</td><td rowspan="2">PROBABILITY THEORY AND RANDOM VARIABLES</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Co- requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Engineering and Science</td></tr>
</table>

Course Description:

To expose the students to the basics of probability theory and random processes essential for modelling and quantifying uncertainties and noise in systems

Course Educational Objectives:

- To know about various random life length models and their uses in finding the reliability of different electronic devices.
- To learn about basic properties and characteristics of various random processes with reference to signal and trunk processes.

UNIT 1 Probability 5 Hours

Axioms of probability theory. Probability spaces. Joint and conditional probabilities. Bayes' Theorem- Independent events.

UNIT 2 Random Variable 5 Hours

Random variables and random vectors. Distributions and densities. Independent random variables. Functions of one and two random variables.

UNIT 3 Multiple Random Variables 6 Hours

Vector random variables, joint distribution and density functions, properties, conditional distribution and density, statistical independence, distribution and density of a sum of random variables, central limit theorem.

UNIT 4 Expected Value of a Function of Random Variables 6 Hours

Joint moments about the origin, joint central moments, jointly Gaussian random variables - two random variables case, N random variable case.

UNIT 5 Random Process 6 Hours

Temporal characteristics - the random process concept, stationarity and statistical independence, correlation functions, Gaussian random processes, Poisson random process.

Textbooks:

1. Peyton Z. Peebles, Probability, Random Variables and Random Signal Principles, 4/e, Tata McGraw Hill, 2002.
2. Athanasios Papoulis, S. Unnikrishnan Pillai, Probability, Random Variables and Stochastic Processes, 4/e, Tata McGraw Hill, 2002.

References:

1. Simon Haykin, Communication Systems, 4/e, Wiley Student Edition, 2006.
2. Henry Stark, John W. Woods, Probability and Random Processes with Application to Signal Processing, 3/e, Pearson Education, 2002.

Course Outcomes:

Upon successful completion of this course, the student should be able to

1. Analyze the outcomes of random experiments and develop the concept of random variables and obtain probabilities through them
2. define single random variables in terms of their PDF and CDF, and calculate moments such as the mean and variance
3. explore the random experiments specified by multiple random variables and study the Distribution of them
4. apply the fundamentals of probability theory and random processes to practical engineering problems
5. identify and interpret the key parameters that underlie the random nature of the problems

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

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SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

<table>
<tr><td rowspan="2">MATH2321</td><td rowspan="2">RANDOM PROCESSES</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Co- requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Engineering and Science</td></tr>
</table>

Course Description:

This course is designed to impart knowledge on random processes needed in applications such as signal processing, digital communications, speech processing, data modelling, etc.

Course Educational Objectives:

1. To familiarize the students in the concepts of probability and random variables.
2. To study Random Processes, its types, distribution, and density functions.
3. To study Gaussian and Poisson processes.
4. To apply random process to signal processing in communication systems.
5. To apply skills in analysing random phenomena which occur in Electrical and Electronics Engineering applications.

UNIT 1 Random Processes 6 Hours

Temporal characteristics - the random processes concept, Classification of random processes, stationarity and statistical independence. Time averages and Ergodicity.

UNIT 2 Correlation and Covariance functions 5 Hours

Auto correlation, Cross correlation, Properties. Covariance functions. Gaussian random processes, Poisson random processes

UNIT 3 Density functions 5 Hours

Probability density and joint probability density functions, Properties.

UNIT 4 Spectral densities functions - I 5 Hours

Spectral characteristics, the power density spectrum: Properties, relationship between power density spectrum and autocorrelation function.

UNIT 5 Spectral densities functions-II 5 Hours

Cross-power density spectrum, Properties, relationship between cross power spectrum and cross-correlation function.

Textbooks:

1. Peyton Z. Peebles, Probability, Random Variables and Random Signal Principles, 4/e, Tata McGraw Hill, 2002.

References:

1. Athanasios Papoulis, S. Unnikrishnan Pillai, Probability, Random Variables and Stochastic Processes, 4/e, Tata McGraw Hill, 2002.
2. Simon Haykin, Communication Systems, 4/e, Wiley Student Edition, 2006.
3. Henry Stark, John W. Woods, Probability and Random Processes with Application to Signal Processing, 3/e, Pearson Education, 2002.

Course Outcomes:

At the end of the course, the student will be able to:

- solve the problems on multiple random variables, joint distribution and independence
- solve the problems Gaussian and Poisson processes
- understand the concept of random processes
- determine covariance and spectral density of stationary random processes
- characterize the random signals in communication systems with their autocorrelation and power spectral density functions

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

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SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

<table>
<tr><td rowspan="2">MATH2351</td><td rowspan="2">OPTIMIZATION METHODS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Co- requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Engineering and Science</td></tr>
</table>

Course Description:

Optimization is the art of finding the best result under given conditions. In this fast-expanding world, an engineer has to use many Optimization methods, as it is the most significant in decision-making, design, manufacturing, maintenance, planning, and scheduling.

Course Educational Objectives:

This course is designed to:

- introduce various optimization methods for solving real-world problems
- find optimal solutions to transportation, assignment, and sequencing problems
- know project planning and scheduling
- study the network analysis techniques through CPM and PERT

UNIT 1 Transportation Problem 6 Hours

Introduction and LP formulation of Transportation Problem, feasible solution, basic feasible solution, finding Initial basic feasible solutions by North West corner rule, Least-cost entry method, Vogel's approximation method, Transportation Algorithm (MODI Method) to find an optimal solution.

UNIT 2 Assignment Problems 5 Hours

Introduction to Assignment Problem, Mathematical formulation, Hungarian Method for finding optimal solution, unbalanced assignment problem, Travelling Salesman Problem.

UNIT 3 Sequencing Problem 4 Hours

Introduction, Basic terminology, Algorithms to obtain optimal solutions for sequencing problems with n jobs and two machines and n jobs and k machines.

UNIT 4 Network Analysis in Project planning 4 Hours

Project, Project Planning, Project Scheduling, Project Controlling, Work breakdown structure, Network Techniques, terms used in network-activity, event, path, network, dummy activity, looping, Fulkerson's rule, network diagram, and activity on node diagram.

UNIT 5 PERT and CPM 7 Hours

Critical path method (CPM), Measure of activity, Critical path analysis, the four floats, subcritical and supercritical activities, slack, Programme evaluation and review technique (PERT), time estimates, frequency distribution curve for PERT

Text Books:

1. Operations Research by S.D.Sarma, Kedarnath, Ramnath and company, 15th edition, 2008.
2. Operations Research An Introduction by Hamdy A. Taha, 8th edition, Pearson, 2007.

References:

1. Linear Programming by R K Gupta, Krishna Prakashan Mandir, 13th edition 2014.
2. Operations Research Theory and Applications by J K Sharma, 4th edition, Macmillan Publishers India Ltd, 2009

Course Outcomes:

On successful completion of this course, students will be able to:

1. apply MODI method for finding optimal transportation cost
2. apply Hungarian Method for solving assignment problems and finding an optimal route to the salesman
3. understand the process of finding optimal sequencing for processing jobs on machines
4. understand the network terminology and construction
5. apply CPM and PERT techniques for project management

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

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SDG Justification:
Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH2331	COMPUTATIONAL METHODS	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	**NIL**						
Co- requisite	**NIL**						
Preferable exposure	**Engineering and Science**						

Course Description:

This course is designed for Aerospace Engineering undergraduate students. It is designed for the students for the basic understanding of techniques for numerical solution of algebraic equations, differentiation, integration used to solve aerospace engineering application problems.

Course Educational Objectives:

1. Develop the mathematical skills in the areas of numerical methods.
2. Focus on the theory and applications of numerical methods in many engineering subjects which require solutions of linear systems, finding eigenvalues, eigenvectors, Interpolation, and applications, solving ODEs, PDEs.
3. Help in the foundation of computational mathematics for postgraduate courses, specialized studies, and research.
4. Train in developing the codes for implementing the numerical methods using any programming languages.
5. Formulate a mathematical model for a given engineering problem

UNIT 1 Mathematical Modeling of Engineering Problems 5 Hours

Approximations: Accuracy and precision, round-off and truncation errors, error problem with example problems. **Roots of Equations:** Formulations of linear and non-linear algebraic equations, solution with bisection, Newton-Raphson and Secant methods. Application to practical problems. **Algebraic Equations**: Formulation of linear algebraic equations from engineering problems, solution of these problems by Gauss elimination method, pitfalls of elimination and techniques for improving the solutions, Gauss Seidel iteration for solving sparse equations by avoiding storage of zero coefficients in matrix, convergence of iteration methods. LU decomposition methods for symmetric (Chelosky) matrices.

UNIT 2 Eigenvalues and Eigenvectors Problems 5 Hours

Formulation of equations to column, truss, spring-mass and friction problems. Solutions for the largest and smallest eigenvalues and corresponding eigenvectors. **Interpolation Methods:** Polynomial interpolation, Lagrange interpolation polynomials with equi- spaced data. **Regression or Curve Fitting:** Linear regression by least squares method.

UNIT 3 Initial Value Problems 6 Hours

Ordinary differential equations, Euler, Heun's and Ralston methods. Runge- Kutta method of 2nd and 4th order, application to vibration and heat transfer problems. **Boundary Value Problems:** Linear and nonlinear ordinary differential equations, boundary value problems over semi-infinite domain, solution of nonlinear equations by finite difference method.

UNIT 4 6 Hours

Laplace Equations: Finite difference discretization of computational domain, different types of boundary conditions, solution to elliptic equations. **Parabolic Transient Diffusion Equations:** Explicit and implicit formulation, Crank Nicolson Method.

UNIT 5 Numerical Integration 6 Hours

Trapezoidal, Simpson's 1/3 and 3/8 rule and Gauss quadrature method.

List of Computational Exercises:

1. Determine the real root for a given polynomial equation by (i) Bisection, (ii) Newton-Raphson until the approximate error falls below 0.5%.
2. Solve the system of simultaneous linear equations by
   i. Naïve -Gauss elimination
   ii. Gaussian elimination with partial pivoting
   iii. Gauss -Seidel method.
   iv. LU decomposition
3. Implement power method to find Eigenvalues and Eigenvectors for Spring mass system
4. Solve the parabolic partial differential equations by using explicit, implicit and semi-implicit methods
5. Solve the elliptic partial differential equations by finite difference techniques.
6. Finding the integral for a second-order polynomial using Gauss quadrature formula.
7. Solve numerical differentiation problems using Runge-Kutta 2^{nd} and 4^{th} order methods.
8. Find the integral by numerical methods such as Trapezoidal and Simpson's rule.

Textbooks:

1. S.P. Venkateshan, P. Swaminathan, Computational Methods in Engineering, 1/e, Ane Publisher, 2014.
2. S.C. Chapra, R.P. Canale, Numerical Methods for Engineers, 6/e, Tata McGraw-Hill, 2012.

References:

1. S.K. Gupta, Numerical Methods for Engineers, 1/e, New Age International, 2005

Course Outcomes:

At the end of the course, the student will be able to:

1. Demonstrate understanding of common numerical methods and how they are used to

obtain approximate solutions to otherwise intractable mathematical problems.
2. Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
3. Analyse and evaluate the accuracy of common numerical methods.
4. Implement numerical methods using any programming language (matlab, scilab, python…)
5. Write efficient, well-documented code and present numerical results in an informative way.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4
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SDG Justification:
Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH1061	Introduction to Mathematics - I	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	**NIL**						
Co- requisite	**NIL**						
Preferable exposure	**Engineering and Science**						

Course Description:

This course is designed to introduce the mathematics required for basic physics, engineering mathematics, and introductory engineering courses.

Course Educational Objectives:

- To explain the concepts of Trigonometry.
- To explain the basic concepts of differentiation and differential equations
- To teach the evaluation of definite and indefinite integrals.
- To explain the basic concepts of differential equations, multivariable and vector calculus

UNIT 1 : Representations , Co-ordinate systems and Trigonometry 3 Hours

Representations for Scalars, Vectors, Matrices and Tensors. Coordinate systems: cartesian and polar coordinate systems.

Trigonometry: Trigonometric functions, Periodicity, Trigonometric Ratio of Compound angles, multiple and sub multiple angles, transformations, brief introduction of inverse trigonometric, hyperbolic and inverse hyperbolic functions.

UNIT 2 Differential Calculus 3 Hours

Limits and Continuity: Definition of right hand limit, left hand limit, standard limits

(without proofs)**,** definition of continuity and simple illustrations.

Differentiation: Introduction, definition, differentiation of a function at a point and on an interval, derivative of a function, differentiation of sum, difference, product and quotient of functions, differentiation of algebraic, exponential, logarithmic functions, composite, implicit, parametric, hyperbolic, inverse hyperbolic functions, derivatives of first and second order.

UNIT 3 Integration 8 Hours

Indefinite Integrals: Integration as the inverse process of differentiation, standard forms, properties of integrals, integration by the method of substitution covering algebraic, trigonometric, exponential functions, integration by parts, logarithmic functions, inverse trigonometric functions.

Definite Integrals: Definition of a definite integral and its properties (without proof)

UNIT 4 Introduction to differential equations , Multivariable calculus, and Vector Calculus 8 Hours

Differential Equations : Order and degree of a ordinary differential equations, Formation of ordinary differential equations

Multivariable Calculus : Limits and continuity of functions of two or more variables, Partial derivates, Total derivates(without problems)

Vector Calculus : Gradient, Divergence and Curl (with simple problems), Introduction to line, surface and volume integrals (without problems) illustrated with Stokes, Gauss, and Green's theorems (Only statements).

Textbooks:

1. Text book for Intermediate Mathematics, Board of Intermediate Education, AP, Volumes IA, IB & IIA, 2018.
2. NCERT class XI and XII (part 1) Mathematics text books.
3. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.

References:

1. V. Venkateswara Rao, N. Krishna Murthy, B.V.S.Sharma, Intermediate Mathematics, S.Chand & Company Ltd., Volume I & II.
2. Chandrika Prasad, A first Course in Mathematics.
3. Text book for Intermediate Mathematics, Deepti Publications.

Course Outcomes:

After the completion of the course the student should be able to

- solve problems involving trigonometric functions
- understand the principles of differential calculus
- evaluate integration using various techniques
- understand the basic concepts of ordinary differential equations,
- understand the basic concepts of multivariable and vector calculus

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

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SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

		L	T	P	S	J	C
MATH1071	**INTRODUCTION TO MATHEMATICS - II**	**2**	**0**	**0**	**0**	**0**	**2**
Pre-requisite	**NIL**						
Co- requisite	**NIL**						
Preferable exposure	**Engineering and Science**						

Course Description:

This course is designed to introduce the mathematics required for basic physics, engineering mathematics, and introductory engineering courses.

Course Educational Objectives:

1. To describe the basic concepts of matrices
2. To introduce complex numbers and their properties.
3. To teach the techniques based on partial fractions
4. To explain the concepts of straight lines and circles
5. To impart knowledge on solid geometry.
6. To demonstrate the solution of a problem using computational

UNIT 1 Matrices 6Hours

Matrices, determinants, definition, types of matrices, algebra of matrices, properties of determinants of 2 X 2, 3 X 3 matrices, inverse of a matrix, solving simultaneous linear equations in two and three variables using matrix inverse method, Cramer's rule and Gauss Jordan method. Eigenvalues and Eigenvector of matrices.

UNIT 2 Complex Numbers 6 Hours

Complex number as an ordered pair of real numbers, representation of z⍰ (a, b) in the form (a + ib) conjugate complex numbers, modulus and amplitude of a complex number, geometrical representation of a complex number, Argand diagram.

UNIT 3 Partial Fractions 6 Hours

Introduction, resolving g(x) into partial fractions when g(x) contains non repeated linear factors, repeated linear factors, repeated and non-repeated irreducible quadratic factors.

UNIT 4 Co-ordinate Geometry 6 Hours

Straight lines: General equation of a straight line,line passing through the point of intersection of two given lines, angle between two intersecting lines, condition for perpendicularity and parallelism, length of the perpendicular from a point to a straight line, distance between two parallel lines (without proofs).

Circles: Equation of a circle, centre and radius, equation of a circle through three non collinear points, parametric equations of a circle.

Unit V Solid Geometry 6 hours

Solid Geometry: Equation of a plane, Intersection of two planes, Equation of a sphere in spherical and cartesian coordinates, Intersection of a plane and a sphere.

Textbooks:

1. Textbook for Intermediate Mathematics, Board of Intermediate Education, AP, Volumes IB, IIA & IIB, 2018.
2. NCERT class XI and XII (part 1 & 2) Mathematics text books.

References:

1. V. Venkateswara Rao, N. Krishna Murthy, B.V.S. Sharma, Intermediate Mathematics, S. Chand & Company Ltd., Volume I & II.
2. Chandrika Prasad, A first Course in Mathematics.
3. Text book for Intermediate Mathematics, Deepti Publications.

Course Outcomes:

After the completion of the course the student should be able to

1. describe the properties of matrices
2. describe the properties of complex numbers
3. find a fractional function and resolve it into partial fractions
4. illustrate straight-line and circle properties and describe different regions in different co-ordinate systems
5. illustrate the procedure to solve a problem using math software

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

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SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH2361	PROBABILITY AND STATISTICS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	**NIL**						
Co- requisite	**NIL**						
Preferable exposure	**Engineering and Science**						

Course Description:

Probability theory is important when it comes to evaluating statistics. This course treats the most common discrete and continuous distributions, showing how they use in decision and estimation problems, and constructs computer algorithms for generating observations from the various distributions.

Course Educational Objectives:

1. To familiarize the students with the foundations of probability and statistical methods
2. To impart concepts in probability and statistical methods in engineering applications.

UNIT 1 Data Science and Probability 10 Hours

Data Science: Statistics introduction, Population vs Sample, collection of data, primary and secondary data, types of variables: dependent and independent Categorical and Continuous variables, data visualization, Measures of central tendency, Measures of dispersion (variance).

Probability: Probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem (without proof).

UNIT 2 Random Variable and Probability Distributions 8 Hours

Random variables (discrete and continuous), probability density functions, probability distribution - Binomial, Poisson and normal distribution-their properties (mathematical expectation and variance).

UNIT 3 Correlation, Regression and Estimation 8 Hours

Correlation, correlation coefficient, rank correlation, regression, lines of regression, regression coefficients, principle of least squares and curve fitting (straight Line, parabola and exponential curves). **Estimation:** Parameter, statistic, sampling distribution, point estimation, properties of estimators, interval estimation.

UNIT 4 Testing of Hypothesis and Large Sample Tests 8 Hours

Formulation of null hypothesis, alternative hypothesis, the critical region, two types of errors, level of significance, and power of the test. Large Sample Tests: Test for single proportion, difference of proportions, test for single mean and difference of means. Confidence interval for parameters in one sample and two sample problems

UNIT 5 Small Sample Tests 6 Hours

Student t-distribution (test for single mean, two means and paired t-test), testing of equality of variances (F-test), χ2 - test for goodness of fit, χ2 - test for independence of attributes.

Textbooks:

1. Miller and Freunds, Probability and Statistics for Engineers,7/e, Pearson, 2008.
2. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012.

References:

1. S. Ross, A First Course in Probability, Pearson Education India, 2002.
2. W. Feller, An Introduction to Probability Theory and its Applications, 1/e, Wiley, 1968.

Course Outcomes:

Upon successful completion of this course, the student should be able to

1. classify the concepts of data science and its importance
2. apply discrete and continuous probability distributions
3. explain the association of characteristics through correlation and regression tools
4. identify the components of a classical hypothesis test
5. infer the statistical inferential methods based on small and large sampling tests

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO3	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO4	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MECH1011	ENGINEERING VISUALIZATION AND PRODUCT REALIZATION	L	T	P	S	J	C
		0	0	4	0	0	2
Pre-requisite	Nil						
Co- requisite	3D Printing						
Preferable exposure	Fusion 360 Additional Modules						

Course Description:

This course introduces basic engineering drawing concepts such as projections, sectional views, and utility of drafting and modelling packages. The course imparts the knowledge of modelling and assembling of components using CAD software. The course also includes preparation of 3D models using 3D printing. The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and always promote learning opportunities.

Course Educational Objectives:

1. To create awareness of engineering drawing as relevant to industry standards.
2. To improve visualization abilities essential for successful engineering design.
3. To impart 2D sketching and 3D modeling using the relevant software.
4. To teach assembly drawing and simulation of motion between mating components.
5. To introduce basic 3D printing software for preparing the products for printing.

List of experiments:

1. Manual Drawing: Introduction to Engineering graphics: Principles of Engineering Graphics and their significance, conventions in drawing lettering, BIS Conventions, Dimensioning, Sectional Views
2. Free hand sketching, Free hand sketching of isometric & orthographic views and interpretation of drawings.
3. Computer Aided Drafting, Introduction to CAD software: Basic draw and Modify commands in 2d
4. Introduction to 2D and 3D modelling using CAD packages
5. Assembly drawings, Assembly of individual 3D components, animation of motion
6. Coordinating multiple moving parts under joint constraints.
7. 3D printing, Introduction to 3D printing software, slicing.
8. Grading and rendering of simple geometries using software.

List of Projects:

Any one project among the following can be opted by the student and submitted:IC Engine Model (3D printed mini model)

- Belt Drive for a bike
- Four Wheel Drivable
- ATV Robot
- Toy making
- Carrom board
- Chess board and pieces model toy train,
- Avengers
- Building Bridges dams etc.,
- Wind Turbine Model etc
- Design of Radar and 3D Printing of Radar
- Models' Programmable logic Controllers –PLC
- Arduino Board Design and 3D Printing of Enclosures for Arduino Boards
- Design of mini mother boards

Text Books:

1. N D Bhatt, 'Engineering Drawing',53,Charotar Publishers, Gujarat India,2019,9789380358963
2. Lydia Sloan Cline,'Fusion 360 for Makers: Design Your Own Digital Models for 3D Printing and CNC Fabrication – Import, 5 June 2018 ',1,Make Comm**UNIT** y LLC,USA,2018,9781680456509

References:

1. Randy Shih,'Parametric Modeling with Autodesk Fusion 360 ',(Spring 2021 Edition),SDC Publications,Squibb Road Mission, KS,2021,1630574376, 9781630574376

Online Resources:

1. Introduction-to-parametric-modeling. 14, 2021, 1:27 p.m., https://www.ascented.com/courseware/product/autodesk-fusion-360--introduction-to-parametric-modeling
2. PP Song et al.,,'https://www.researchgate.net/publication/325189986_Research_and_Application_of_Autodesk_Fusion360_in_Industrial_Design', 2018,8

Course Outcomes:

1. Prepare drawings as per international standards.
2. Utilize Engineering visualization as Language of Engineers.
3. Sketch 2D models using CAD software
4. Sketch 3D models using CAD package.
5. Develop model for printing simple objects using 3D printer

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2		1	1	2							3	1	1
CO2	3	3		2	1	3	1		2	1	1		2	2	1
CO3	2	3		3	1	2			2	1	2		3	2	1
CO4	2	3		3	1	3							3	2	2
CO5	3	3	3	3	3	3		2		3	3	1	3	2	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:
SDG 4 - ensure all-inclusive and thorough education with equity to all persons and always promote learning opportunities.
SDG-9 engineers build resilient infrastructure which promote inclusive and sustainable industrialization and foster innovation*.*
SDG Justification:
SDG 4-The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and always promote learning opportunities.
SDG 9-The modules and topics mentioned in this course are designed to ensure the engineers build resilient infrastructure which promote inclusive and sustainable industrialization and foster innovation.

MECH1041	TECHNOLOGY EXPLORATION & PRODUCT ENGINEERING	L	T	P	S	J	C
		0	0	4	0	0	2
Pre-requisite	None						
Co-Requisite	Engineering Visualization and Product Realization						
Preferable Exposure	Power tools and Basic Electronics						

Course Description:
This is a fundamental engineering course that introduces the incoming students to hands-on product development experience using a combination of Mechanical Engineering and IoT concepts, programming with application of EVPR concepts and exposure to project planning.

Course Educational Objectives:
- Inculcate creativity, critical thinking and problem-solving skills with hands-on approach to all incoming freshmen.
- Emphasise product development using systems engineering approach.
- Impart multidisciplinary project-based skills with a combination of IoT, Programming, Simulation, Mechanisms and Machining.
- Involve Ideation to develop a variety of solutions to a problem statement rather than performing a standard job/experiment.
- Project planning and management to deliver the assigned project within the timeline.

SYLLABUS
- Manufacturing economics
- Evaluation of manufacturing strategies
- OBHS (Operational Behaviour, health, safety in hazardous environment)
- Power tools operations and safety – Angle grinder (Cutting, Grinding and Polishing), Driller and Jigsaw.
- Basics of Microprocessors and Microcontrollers
- General Introduction to Arduino, Node MCU, and Raspberry Pi.
- Basics of Electronics: General Introduction to the usage of Breadboard, Digital Multimeter, General Connections, Usage of Resistors, Capacitors, LEDs.
- Basics of Arduino & Node MCU coding – Libraries, board & port selection, baud rate, Basics of Troubleshooting, Cloud Interfacing etc.
- Usage and Applications of Basic Sensors: Ultrasonic, Voltage/Current, Temp/Humidity, Gas, IR
- Basics of Electromagnetism – Permanent Magnet DC Motor (PMDC), Brushless DC Motor (BLDC), Stepper and Servo Motors.
- Basics of Drawing/Circuit Simulation - Line diagram, Tinker CAD, Multisim, PROTEUS

- Basics of Mechanisms - Linear motion, Cam mechanism, Belt drive, gears
- Demonstration of Carpentry, Tin smithy, Fitting, Welding and Injection Moulding.
- Problem identification and understanding the needs of the users
- Project management and planning.

Project: All students must work in teams to complete a product/prototype of a given problem statement with the topics covered in the class.

Textbooks:

1. Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram, Internet of Things, Wiley India, 2019
2. Simon Monk, Programming Arduino: Getting Started with Sketches, Mc Graw Hill Publications, 2011

References:

1. Essaid, a. (2019). 507 Mechanical Movements: Mechanisms and How They Work (Dover Science Books). (n.p.): Independently Published.

Course Outcomes

At the end of the course, the student will be able to:

1. Perform basic mechanical operations with power tools.
2. Understand and apply IoT concepts to drive mechanical components.
3. Apply multidisciplinary skills to solve practical engineering problems.
4. Conceptualize and work towards the creation of physical products.
5. Think along the lines of innovation and entrepreneurship.

CO-PO Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1									1			3	2	1	1
CO2	3	3	3		1							2	1	1	1
CO3	2	3	3	1	1	1			3	2	3	1	2	1	1
CO4	3	3	3	1	1	1	1	1	1	3	3		2	1	1
CO5													2	1	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 21-04-2023 **ACADEMIC COUNCIL: 19-06-2023**

SDG No. & Statement:

SDG 4: Ensure all-inclusive and thorough education with equity to all persons and always promote learning opportunities.

SDG 9: Engineers build resilient infrastructure which promote inclusive and sustainable industrialization and foster innovation.

SDG Justification:

SDG 4: The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and always promote learning opportunities.

SDG 9: The modules and topics mentioned in this course are designed to ensure the engineers build resilient infrastructure which promote inclusive and sustainable industrialization and foster innovation.

MECH1001	DESIGN THINKING	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	Nil						
Co- requisite	Nil						
Preferable exposure	Nil						

Course Pre-requisite(s): Engineering Visualization and Product Realization

Course Description:

Design is a realization of a concept or idea into a configuration, drawing or product. Design Thinking is the cognitive and practical process by which design concepts are developed by designers. Innovation is a new idea or a new concept. Product development is the creation of a new or different product that offers new benefits to the end-user. This course introduces design thinking in product innovation.

Course Educational Objectives:

1. To familiarize the product design process
2. To introduce the basics of design thinking
3. To bring awareness on idea generation
4. To familiarize the role of design thinking in services design

Topic	Type
Each member of the group has to ask (vocally) the group members different questions about a product that they would like to design. Write down the questions and answers and submit as a word or pdf document.	Exercise
Each member of the group must ask (vocally) the group members questions about the product chosen in the previous experiment. This helps to gain indepth insights as well as new findings and information in order to grasp the problem or situation holistically or simply to find relevant questions for an interview. Write down the questions and answers and submit as a word or pdf document	Exercise
Identify relevant factors of influence that constitute the basis for a new or improved product or offer; then analyze it in a targeted manner. ➢ Make sure that you are sufficiently creative in the analysis process, because the focus is on technical “details”. ➢ Boost the efficiency of the analysis process by avoiding empty runs. ➢ Make use of a standardized procedure in order to examine the problem and solution space again with the help of data.	Exercise
➢ Do research, talk with people, and have empathy to formulate profound stories. ➢ Summarize the results from the “understand” and “observe” phases and discuss with the team. ➢ Highlight unexpected results and generate new perspectives.	Exercise

➢ In general, share insights, ideas, and results (solutions) with others. ➢ Explore untapped market opportunities. ➢ Provide differentiated and new offers based on the user needs. ➢ Adapt a strategy to new market needs by understanding the competitive edge. ➢ Establish the right vision for the design challenge or a road map for stepby-step implementation and control mechanisms.	Exercise
➢ Find out at an early stage whether the basic need is satisfied and the product attracts interest on the market. ➢ Find out through iterative testing whether the user need is met with a minimally functional product and how the product should be enhanced. ➢ Find out through user feedback how much demand there is for the product before developing further details and features. ➢ Minimize the risk of investing in a solution for which there is little demand on the market, thus saving time, money, and energy.	Exercise
➢ Perform a true A/B test or several variants of a prototype in the form of a multi-variants test or as split testing. ➢ Do a quantitative evaluation. ➢ Carry out a qualitative survey and evaluate the number and content of feedbacks. ➢ Compare individual variants of a function or a prototype (e.g. buttons, visuals, arrangement).	Exercise
➢ Collect and appraise experiences made in the project in a structured manner. ➢ Learn from experience and make use of it in the next project. ➢ Facilitate a positive attitude toward mistakes and appreciate progress. ➢ Identify and document the findings; make them applicable and usable.	Exercise
Case Studies: Example : Software Prototyping, Additive Manufacturing; Design of Arduino Boards for various applications etc	Exercise

Text Books:

1. Pahl, Beitz, Feldhusen, Grote,'Engineering Design: a systematic approach',3rd,Springer Science & Business Media,London,2007,978-1846283185
2. Christoph Meinel,Larry Leifer,Hasso Plattner,'Design Thinking Understand – Improve – Apply',1st,Springer,Berlin, Heidelberg,2011,978-3-642-13756-3

References:

1. Marc Stickdorn, Jakob Schneider,'This is Service Design Thinking: Basics, Tools, Cases',1st,WILEY,United States,2012,978-1-118-15630-8

Course Outcomes:

1. Innovate new methods in product development
2. 2 Apply Design Thinking in developing the new designs

3. Select ideas from ideation methods in new product development
4. Use Design Thinking in developing software products
5. Apply principles of Design Thinking in service design

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2		1	1	2							3	1	1
CO2	3	3		2	1	3	1		2	1	1		2	2	1
CO3	2	3		3	1	2			2	1	2		3	2	1
CO4	2	3		3	1	3							3	2	2
CO5	3	3	3	3	3	3		2		3	3	1	3	2	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS: 29-4-2021 **ACADEMIC COUNCIL: 17-9-2021**

SDG No. & Statement:
SDG 9
The modules and topics mentioned in this course are designed to ensure the engineers build resilient infrastructure which promote inclusive and sustainable industrialization and foster innovation.
SDG Justification:
The course involves design aspects

<table>
<tr><td rowspan="2">PHYS1001</td><td rowspan="2">PHYSICS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>1</td><td>2</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Co- requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">NIL</td></tr>
</table>

Course Description:

This course is designed with fundamentals of electromagnetism and properties of materials for advanced courses in their respective engineering branches. It introduces electromagnetic theory with relevant mathematical tools, optical fibres and their propagation characteristics, properties of dielectric and magnetic materials. It also introduces principles of semiconductors and some widely used semiconductor devices for various applications.

Course Educational Objectives:

1. To introduce mathematical principles to estimate forces, fields and waves.
2. To familiarize students with electromagnetics in modern communication systems.
3. To impart knowledge concerning the electrical behaviour of dielectric materials.
4. To demonstrate the properties of magnets.
5. To introduce semiconductor physics and devices.

UNIT 1 Basics of Electromagnetics 9 Hours

Electrostatic field: Coulomb's law and Gauss 'law, derivation of Coulombs law from Gauss' law, applications of Gauss' law (line charge, thin sheet of charge and solid charged sphere), Gauss' law of electrostatics in dielectric medium, divergence and curl of electric fields, electric potential, relation between potential and force, Poisson's and Laplace equations. Magnetostatic field: Biot–Savarts' law, divergence and curl of magnetic fields, Faraday's and Ampere's laws in integral and differential form, displacement current, continuity equation, Maxwell's equations.

UNIT 2 Fiber Optics 7 Hours

Introduction, advantages of optical fibers, principle and structure, acceptance angle, numerical aperture, modes of propagation, classification of fibers, fiber optic communication, importance of V-number, fiber optic sensors (Temperature, displacement and force), applications.

UNIT 3 Dielectric, Magnetic and superconducting Materials 10 Hours

Dielectric materials: Introduction, electric polarization, dielectric polarizability, susceptibility and dielectric constant, types of polarizations (qualitative treatment only). Magnetic materials: Introduction, magnetic dipole moment, magnetization, magnetic susceptibility and permeability, origin of permanent magnetic moment, classification of magnetic materials, Weiss theory of ferromagnetism (qualitative), domain theory, hysteresis, soft and hard magnetic materials.

Superconductivity: definition –Meissner effect –type I & II superconductors –BCS theory (qualitative) –high temperature superconductors –Josephson effects applications.

UNIT 4 **Semiconductor Physics** **8 Hours**

Introduction, origin of energy band, intrinsic and extrinsic semiconductors, mechanism of conduction in intrinsic semiconductors, generation and recombination, carrier concentration in intrinsic semiconductors, variation of intrinsic carrier concentration with temperature, n-type and p-type semiconductors, carrier concentration in n-type and p- type semiconductors, Drift and diffusion currents in semiconductors.

UNIT 5 **Semiconductor Devices** **8 Hours**

Zener Diode, Tunnel diode, Hall effect and its applications, magnetoresistance, p-n junction layer formation and V-I characteristics, direct and indirect band gap semiconductors, construction and working of photodiode, LED, solar cell.

PHYSICS LABORATORY

List of Experiments

1. To determine the magnetic field along the axis of a circular coil carrying current.
2. To determine the numerical aperture of a given optical fiber and hence to find its acceptance angle
3. To determine magnetic susceptibility by Quincke's tube method
4. To determine the Hall coefficient using Hall effect experiment
5. To determine the resistivity of semiconductor by Four probe method
6. To determine the energy gap of a semiconductor.
7. To study the characteristics of PN Junction diode.
8. To study magnetic hysteresis loop (B-H curve).
9. To determine the dielectric constant of a substance by resonance method.
10. To determine hysteresis loss by CRO.
11. To study the characteristics of Photodiode
12. To study the characteristics of Solar Cell
13. To study the characteristics of Zener diode
14. To study the resonance of LCR circuit

Text Books:

1. David J.Griffiths, "Introduction to Electrodynamics", 4/e, Pearson Education, 2014.
2. Charles Kittel, "Introduction to Solid State Physics", Wiley Publications, 2011.
3. M. N. Avadhanulu, P.G. Kshirsagar, "A Text book of Engineering Physics", 11/e, S. Chand Publications, 2019.

References:

1. Principles of Physics, 10ed, ISV, Jearl Walker, David Halliday, Robert Resnick, Wiley India.
2. Gerd Keiser, "Optical Fiber Communications", 4/e, Tata Mc Graw Hill, 2008.
3. S.O.Pillai, "Solid StatePhysics", 8/e, New Age International, 2018.

4. S.M. Sze, “Semiconductor Devices-Physics and Technology” , Wiley, 2008.

Journal(s):

1. https://aapt.scitation.org/doi/abs/10.1119/1.3317450
2. https://aapt.scitation.org/doi/full/10.1119/1.5144798
3. https://aapt.scitation.org/doi/abs/10.1119/1.1511591

Course Outcomes:

1. Apply mathematical principles to estimate magnetic and electric forces, fields and waves
2. Use the principles of EM waves and Maxwell equations to understand communication systems
3. Apply basic properties of dielectric, magnetic and superconducting materials in electromagnetics
4. Understand physics of semiconducting materials
5. Use working principles of semiconducting devices in electronic circuits

Text Book:

1. S. Balasubramanian, M.N. Srinivasan “A Text book of Practical Physics”- S Chand Publishers,2017

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1							1			1	1		
CO2	1	1							1			1	1		
CO3	1	1							1			1	1		
CO4	1	1							1			1	1		
CO5	1	1							1			1	1		

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">PHYS1011</td><td rowspan="2">MECHANICS AND PROPERTIES OF MATTER</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Co- requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">NIL</td></tr>
</table>

Course Description:

This course is designed for students of Aerospace, Civil and Mechanical Engineering. It introduces fundamentals of elasticity and thermal properties – the essentials for understanding the behaviour of materials. Mechanics of solids is taught to acquaint them with the behaviour of rigid objects. An introduction to sensors will be useful for all the branches as an application of modern technology.

Course Educational Objectives:

1. To acquaint the basic concepts of sound waves and principles in acoustic design.
2. To introduce the concepts of elasticity, strain hardening and failure in materials and impart the relation between stress and strain.
3. To impart the phenomenon of heat transfer so as to understand a wide variety of practical engineering problems.
4. To demonstrate the use of Newton's laws of motion for understanding the mechanics of a particle.
5. To explain the working principle and construction of different types of sensors.

UNIT 1 Mechanics 10 Hours

Basic laws of vectors and scalars; Rotational frames; Conservative and non-conservative forces; F = - grad V; Central forces; Elliptical, parabolic and hyperbolic orbits; Noninertial frames of reference; Centripetal acceleration; Harmonic oscillator; Damped harmonic motion; Forced oscillations and resonance. Degrees of freedom.

UNIT 2 Elasticity 8 Hours

Concepts of elasticity and plasticity, stress and strain, Hooke's law, different moduli of elasticity, Poisson's ratio, strain energy, stress-strain diagram, elastic behavior of a material, factors affecting elasticity, relation between different moduli of elasticity, determination of elastic moduli.

UNIT 3 Thermal Properties 10 Hours

Transfer of heat energy; Thermal expansion of solids and liquids; Expansion joints - bimetallic strips; Thermal conduction, convection and radiation and their fundamental laws; Heat conductions in solids; Thermal conductivity - Forbe's and Lee's disc method: theory and experiment; Applications (qualitative only): heat exchangers, refrigerators, ovens and solar water heaters.

UNIT 4 Acoustics 8 Hours

Characteristics of sound waves; Weber-Fechner Law; Absorption coefficient, determination of absorption coefficient; Reverberation time; Sabine's formula, derivation of Sabine's formula using growth and decay method; Intensity of sound; Acoustics of buildings, Acoustic requirements of a good auditorium.

UNIT 5 Sensors 9 Hours

Sensors (qualitative description only); Different types of sensors and applications; Strain and pressure sensors- Piezoelectric, magnetostrictive sensors; Fibre optic methods of pressure sensing; Temperature sensor - bimetallic strip, pyroelectric detectors; Hall-effect sensor; Smoke and fire detectors.

Text Books:

1. D.Kleppner and Robert Kolenkow"An Introduction to Mechanics- II" Cambridge University Press,2015.
2. M.N. Avadhanulu & T.V.S. Arun Murthy, S Chand A Textbook of Engineering Physics, Volume-I 2018.
3. Ian R Sinclair, Sensor and Transducers 3/e,Elsevier (Newnes), 2001.

References:

1. M K Varma, "Introduction to Mechanics"-Universities Press, 2015
2. Prithwiraj Purkait, Budhaditya Biswas and Chiranjib Koley, Chapter 11 Sensors and Transducers, Electrical and Electronics Measurements and Instrumentation, 1/e., McGraw Hill Education (India) Private Limited, 2013.

Course Outcomes:

After completion of this course, the student will be able to

1. describe the fundamental principles of acoustics with emphasis on physical mechanisms, law and relationships
2. apply the concepts of strain, internal force, stress and equilibrium to deformation of solids
3. explain the fundamental theory for the analysis of heat transfer processess in solids and liquids and to apply basic principles of heat transfer in design of refrigerators and heaters
4. estimate forces and moments in mechanical systems using scalar and vector techniques
5. outline the basic principle and operation of different types of sensors

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1							1			1		1	1	
CO2	1	1						1			1		1	1	
CO3	1	1						1			1		1	1	
CO4	1	1						1			1		1	1	
CO5	1					1		1			1		1	1	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">PHYS1021</td><td rowspan="2">PRINCIPLES OF QUANTUM MECHANICS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Co- requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">NIL</td></tr>
</table>

Course Description:

This course is designed with principles of Quantum mechanics for advanced courses in their respective engineering branches. It introduces Quantum mechanics with relevant mathematical tools and provides a basis for further study of quantum mechanics. It also introduces basics of Qubits for Quantum computing applications.

Course Educational Objectives:

1. To introduce the basic principles of quantum mechanics.
2. To introduce wave equation and significance of wave function.
3. To teach solving the Schrödinger's equation for spinless particles moving in one-dimensional potential.
4. To develop an understanding of concepts of angular momentum.
5. To introduce Dirac bra-ket formalism and the concept of QUBITs.

UNIT 1 Introduction to Quantum Physics 10 Hours

Introduction, Classical Mechanics vs Quantum Mechanics, Planck's quantum theory (qualitative), Photo-electric effect. De Broglie wavelength and matter waves; Davisson-Germer experiment. Wave description of particles by wave packets. Group and Phase velocities and relation between them, Wave-particle duality, Heisenberg uncertainty principle: ground state energy of hydrogen atom.

UNIT 2 Properties of Matter Waves 8 Hours

Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities, and normalization.

UNIT 3 Quantum Tunneling 8 Hours

One dimensional infinitely rigid box-energy eigenvalues and eigenfunctions, normalization; Quantum dot as example; Quantum mechanical tunnelling in one dimensional rectangular potential barrier, 1D linear harmonic oscillator (no derivation required, only eigen function, eigen values and zero-point energy).

UNIT 4 Quantum Properties of Electrons 9 Hours

Electron angular momentum, angular momentum operator, Space quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Stern-Gerlach Experiment. Zeeman Effect, Stark Effect, Gyromagnetic Ratio and Bohr

Magneton (qualitative)

UNIT 5 Qubits for Quantum Computing 10 Hours

Introduction to Dirac Bra-Ket notation, Introduction to Pauli spin matrices, Quantum Superposition, Interference, Quantum Measurement, Decoherence, Entanglement, Bloch sphere, Qubits, and multiple qubits, Qubits Vs classical bits, representation of a qubit probability.

Textbooks:

1. Quantum Mechanics, G. Aruldhas, 2ndEdn. 2002, PHI Learning of India.
2. Quantum Mechanics, Satya Prakash, 2016, Pragati Prakashan.
3. Quantum Computing for Everyone, Chris Bernhardt, 2019, The MIT Press,

References:

1. Introduction to Quantum Mechanics, D.J. Griffith, 2ndEd. 2005, Pearson Education.
2. Quantum Computing: An Applied Approach, Jack D. Hidary, 2019,

Journal(s):

1. https://aapt.scitation.org/doi/full/10.1119/1.4897588
2. https://aapt.scitation.org/doi/full/10.1119/1.3639154

Websites

1. https://www.intechopen.com/online-first/73811
2. https://www.quantum-inspire.com/kbase/what-is-a-qubit/

Course Outcomes:

At the end of this course, the students will be able to:

1. Explain the basic principles of quantum mechanics.
2. Interpret wave equation and significance of wave function.
3. Solve the Schrödinger's equation for spinless particles moving in one-dimensional potential.
4. Understand of concepts of angular momentum and spin.
5. Apply Dirac bra-ket formalism to the concept of QUBITs.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1							1			2	1		
CO2	1	1							1			2	1		
CO3	1	1							1			2	1		
CO4	1	1							1			2	1		
CO5	2	2							2			2	2	1	

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">PHYS1241</td><td rowspan="2">PHYSICS OF OPTOELECTRONIC DEVICES</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Co- requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">NIL</td></tr>
</table>

Course Description:

This course is designed with fundamentals of electromagnetism and properties of materials for advanced courses in their respective engineering branches. It introduces electromagnetic theory with relevant mathematical tools, optical fibres and their propagation characteristics, properties of dielectric and magnetic materials. It also introduces principles of semiconductors, and some widely used semiconductor devices for various applications.

Course Educational Objectives:

1. To introduce nature light and its properties.
2. To familiarize students with different semiconductors and its energy band gaps.
3. To introduce semiconductor physics and devices.
4. To impart knowledge about the semiconducting optical devices.
5. To demonstrate the properties of different semiconducting optical devices.

UNIT 1 Elements of light 8 Hours

Nature of light, Light sources, Black body, Colour temperature, Units of light, Radio metric and photometric units, Light propagation in media and waveguides, Electro-optic effects. Overview of luminescence: Photoluminescence, Cathodoluminescence, Electroluminescence, Injection-luminescence.

UNIT 2 Semiconductor Materials 10 Hours

Free electron theory of metals, Density of states in 1D, 2D, and 3D, Bloch's theorem for particles in a periodic potential, Energy band diagrams, Kronig-Penny model (to introduce origin of band gap), Energy bands in solids, E-k diagram, Direct and indirect bandgaps, Types of electronic materials: metals, semiconductors, and insulators, Occupation probability, Fermi level, Effective mass.

UNIT 3 Principles of Lasers 10 Hours

Optical transitions in bulk semiconductors: absorption, spontaneous emission, and stimulated emission; Einstein coefficients, Population inversion, Transition rates (Fermi's golden rule), Optical loss and gain; semiconducting diode laser, applications of semiconductor Lasers.

UNIT 4 Solar cells and Photovoltaic devices 9 Hours

Charge carrier generation and recombination, p-n junction model and depletion capacitance, Photovoltaic effect, Physics of Solar Cells, Principle of solar energy conversion,

Conversion efficiency, Type of solar cells in use: Dye Sensitized Solar Cells, Thin film solar cells, Perovskite Solar cell.

UNIT 5 **Semiconductor devices** **8 Hours**

Radiative recombination devices: Light-emitting diodes (LED), Organic Light Emitting Diodes (OLED) and its types, Photoelectric devices: Photodiodes. Photo conducting devices: Photodetectors and photoconductors, Photoresistors, Photo transistors.

Textbooks:

1. Jasprit Singh, Optoelectronics – An Introduction to materials and devices; McGraw Hill,1996.
2. Charles Kittel, Introduction to Solid State Physics, Wiley India Edition 2019
3. Maurice Quillec, Materials for Optoelectronics; Springer Science, 1996.
4. S. C. Gupta, Optoelectronic Devices and Systems; Prentice Hall India, 2005.
5. P. Bhattacharya, Semiconductor optoelectronic devices; Prentice Hall India, 2006.

References:

1. Pyshkin, Ballato, Optoelectronics - Advanced Materials and Devices; InTech, 2013.
2. Manijeh Razeghi, Optoelectronic materials and device concepts; SPIE, 1991
3. Sun and Dalton, Introduction to Organic Electronic and Optoelectronic Materials and Devices; CRC Press, 2008.
4. J. Palais, Introduction to optical electronics; Prentice Hall, 1988.
5. Jasprit Singh, Semiconductor optoelectronics; McGraw-Hill, 1995.

Course Outcomes:

After completion of this unit, the student will be able to

1. Outline the properties of semiconductors
2. explain the occupation probability and Fermi level variation in different electronic materials
3. Know about the interaction of light with materials and its optical properties
4. Explain the conduction mechanism in semiconducting and optical devices.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1							1			1	1		
CO2	2	1							1			2	1		
CO3	1	1							1			2	1		
CO4	2	1					1		1			2	1		1
CO5	2	1					1		1			2	1		1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">PHYS1041</td><td rowspan="2">MECHANICS AND MODERN PHYSICS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Co- requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">NIL</td></tr>
</table>

Course Description:

This course designed for students of Biotechnology to impart principles of Newtonian mechanics will help the students in understanding the oscillatory behavior of materials. It also introduces fundamentals of quantum mechanics – the essentials for understanding the behavior of properties of materials. Fundamentals of optics and electromagnetism in understanding the use in spectroscopy. An introduction to sensors will be useful for all the branches as an application of modern technology.

Course Educational Objectives:

1. To impart knowledge on damped and forced oscillations.
2. To familiarize students with the concepts of quantum mechanics
3. To impart knowledge concerning the wave properties of electromagnetic waves
4. To familiarize the students about the Maxwell's equations and its propagation
5. To outline the principles and working of few common sensing devices

UNIT 1 Fundamentals of Dynamics and Oscillations 10 Hours

Fundamentals of Dynamics: Reference frames. Inertial frames; Galilean transformations.
Galilean invariance. Review of Newton's Laws of Motion.
Oscillations: SHM, Simple Harmonic Oscillations. Differential equation of SHM and its solution. Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor

UNIT 2 Modern Physics (Quantum Physics) 8 Hours

Introduction, matter waves and its properties, Davisson-Germer experiment, GP Thomson experiment, Heisenberg's uncertainty principle, Schrodinger's time independent wave equation, physical significance of wave function, particle in a one-dimensional infinite well, rectangular potential barrier (transmission coefficient), band theory of solids (qualitative), distinction between metals, insulators and semiconductors, introduction to Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstien statistics.

UNIT 3 Optics 10 Hours

Interference: Introduction, interference in thin films due to reflected light: interference in parallel-sided film and wedge-shaped film, Newton's rings. Diffraction: Introduction; Fraunhofer diffraction at single slit (qualitative only), diffraction due to N-slits (diffraction

grating) (qualitative only), determination of wavelength of light with a plane transmission grating.
Polarisation: Introduction; Double refraction –double refraction in calcite crystal, negative and positive crystals, Nicol’s prism, Retarders (quarter and half¬wave plates).

UNIT 4 Maxwell`s equations and Electromagnetic wave propagation 8 Hours

Maxwell’s equations (both differential and integral forms) and its physical significance, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization of EM waves.

UNIT 5 Sensors 9 Hours

Sensors (qualitative description only); Different types of sensors and applications; Strain and pressure sensors -Piezoelectric, magnetostrictive sensors, ultrasonic sensors; Fibre optic methods of pressure sensing; Temperature sensor -bimetallic strip, pyroelectric detectors; Hall-effect sensor; Smoke and fire detectors

Textbooks:

1. Mechanics, D.S. Mathur, S.Chand and Company Limited, 2000.
2. A Text Book of Optics, 25/e, Brij Lal, M N Avadhanulu & N Subrahmanyam, 2012, S. Chand Publishing.
3. Ian R Sinclair, Sensor and Transducers 3rd eds, 2001, Elsevier (Newnes)
4. David J. Griffiths, “Introduction to Electrodynamics”-4/e, Pearson Education,2014
5. M.N. Avadhanulu, P.G. Kshirsagar, A Textbook of Engineering Physics, S.Chand, 2014.

References:

1. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
2. Prithwiraj Purkait, Budhaditya Biswas and Chiranjib Koley, Chapter 11 Sensors and Transducers, Electrical and Electronics Measurements and Instrumentation, 1st eds., 2013 McGraw Hill Education (India) Private Limited.
3. Elements of Properties of Matter, D. S. Mathur, S. Chand Publishing

Journal(s):

1. https://aapt.scitation.org/doi/abs/10.1119/1.3317450
2. https://aapt.scitation.org/doi/full/10.1119/1.3639154

Course Outcomes:

At the end of this course, the students will be able to:

1. Understand the concept of damped and forced oscillations.
2. Understand concepts of quantum mechanics
3. Understand interference, diffraction and polarization of light waves
4. Know about the maxwell’s equations and its propagation
5. Use principles and working of few common sensing devices

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1						1				1	1				
CO2						1				1	1				
CO3						1				1	1				
CO4						1				1	1				
CO5						1				1	1				

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

PROJ2999	CAPSTONE PROJECT – INTRODUCTION	L	T	P	S	J	C
		0	0	0	0	2	2
Pre-requisite	**NIL**						
Co- requisite	**NIL**						
Preferable exposure	**NIL**						

Course Educational Objectives:

1. To provide sufficient hands-on learning experience related to the design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field.

Course Logistics

Capstone Project may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.

1. Project can be for one or two semesters based on the completion of required number of credits as per the academic regulations.
2. Can be individual work or a group project, with a maximum of 3 students.
3. In case of group projects, the individual project report of each student should specify the individual's contribution to the group project.
4. Carried out inside or outside the university, in any relevant industry or research institution.
5. Publications in the peer reviewed journals / International Conferences will be an added advantage

Mode of Evaluation: Periodic reviews, Presentation, Final oral viva, Poster submission

Course Outcomes:

At the end of the course the student will be able to

1. Formulate specific problem statements for ill-defined real life problems with reasonable assumptions and constraints.
2. Perform literature search and / or patent search in the area of interest.
3. Conduct experiments / Design and Analysis / solution iterations and document the results.
4. Perform error analysis / benchmarking / costing
5. Synthesis the results and arrive at scientific conclusions / products / solution
6. Document the results in the form of technical report / presentation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

PROJ3999	CAPSTONE PROJECT – FINAL	L	T	P	S	J	C
		0	0	0	0	6	6
Pre-requisite	PROJ2999						
Co- requisite							
Preferable exposure							

Course Educational Objectives:

1. To provide sufficient hands-on learning experience related to the design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field.

Course Logistics:

Capstone Project may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.

1. Project can be for one or two semesters based on the completion of required number of credits as per the academic regulations.
2. Can be individual work or a group project, with a maximum of 3 students.
3. In case of group projects, the individual project report of each student should specify the individual's contribution to the group project.
4. Carried out inside or outside the university, in any relevant industry or research institution.
5. Publications in the peer reviewed journals / International Conferences will be an added advantage

Mode of Evaluation: Periodic reviews, Presentation, Final oral viva, Poster submission

Course Outcomes:

At the end of the course the student will be able to

1. Formulate specific problem statements for ill-defined real life problems with reasonable assumptions and constraints.
2. Perform literature search and / or patent search in the area of interest.
3. Conduct experiments / Design and Analysis / solution iterations and document the results.
4. Perform error analysis / benchmarking / costing
5. Synthesis the results and arrive at scientific conclusions / products / solution
6. Document the results in the form of technical report / presentation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

PROJ2888	PROJECT EXHIBITION 1	L	T	P	S	J	C
		0	0	0	0	1	1
Pre-requisite							
Co- requisite							
Preferable exposure							

Course Educational Objectives:

To provide platform for the student to exhibit their project work to

1. Excite interested students in continuing/initiating in the work of interest
2. Attract startups/industry to commercialize the project work
3. acquire comments on improving the quality of the work from other students/academicians/industry

Mode of Evaluation: Poster submission, Viva-Voce Examination

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">PROJ3888</td><td rowspan="2">PROJECT EXHIBITION 2</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">PROJ2888</td></tr>
<tr><td>Co- requisite</td><td colspan="7"></td></tr>
<tr><td>Preferable exposure</td><td colspan="7"></td></tr>
</table>

Course Educational Objectives:

To provide platform for the student to exhibit their project work to

- Excite interested students in continuing/initiating in the work of interest
- Attract startups/industry to commercialize the project work
- acquire comments on improving the quality of the work from other students/academicians/industry

Mode of Evaluation: Poster submission, Viva-Voce Examination

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

VIVA3555	COMPREHENSIVE EXAMINATION	L	T	P	S	J	C
		1	0	0	0	0	1
Pre-requisite	Completion of minimum of six semesters						
Co- requisite							
Preferable exposure							

Course Educational Objectives:

1. Designed to test the students on the electronics and communication engineering concepts, and tools, and the process of identifying and solving engineering problems.

UNIT 1 Networks, Signals and Systems

Network solution methods: nodal and mesh analysis; Network theorems: superposition, Thevenin and Norton"s maximum power transfer; ye-Delta transformation; Steady state sinusoidal analysis using phasors; Time domain analysis of simple linear circuits; Solution of network equations using Laplace transform; Frequency domain analysis of RLC circuits; Linear 2-port network parameters: driving point and transfer functions; State equations for networks and Network Synthesis {RL,RC,LC and RLC Synthesis}: Positive real functions, hurwitz polynomial, foster and cauer forms. Continuous-time signals: LTI System & Properties,Fourier series and Fourier transform representations, sampling and aliasing concepts and applications; Discrete-time signals: discrete time Fourier transform {DTFT}, DFT, FFT, Z-transform. Interconnection of systems; Filter design concepts, phase and group delay concepts

UNIT 2 Electronic Devices and Circuits

Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; Generation and recombination of carriers; Poisson and continuity equations; P-N junction, Zener diode, BJT, LED, photo diode and solar cell; MOS Transistor Theory: nMOS, pMOS Enhancement Transistor, ideal I-V characteristics, MOS capacitor, C-V characteristics, DC transfer Characteristics of CMOS inverter. Small signal equivalent circuits of diodes, BJTs and MOSFETs; Simple diode circuits: clipping, clamping and rectifiers; Special diodes, Single-stage BJT and MOSFET amplifiers: biasing, bias stability, mid-frequency small signal analysis and frequency response; BJT and MOSFET amplifiers: multi-stage, differential, feedback, tuned amplifiers, power and operational; Simple opamp circuits; Active filters; Sinusoidal oscillators: criterion for oscillation, single-transistor and op-amp configurations; Function generators, 555 timers, open and closed loop applications of Comparators, Voltage Regulators, regulator protection methods, noise analysis of electronic circuits, PLLs and Data converters

UNIT 3 Digital Circuits

Number systems; Combinatorial circuits: Boolean algebra, minimization of functions using Boolean identities and Karnaugh map, logic gates and their static CMOS implementations, arithmetic circuits, code converters, multiplexers, decoders and PLAs; Sequential circuits: latches and flip-flops, counters, shift- registers and finite state machines; Data converters: sample and hold circuits, ADCs and DACs; Semiconductor memories: ROM, SRAM, DRAM; 8-bit microcontroller {8051}: architecture, programming, memory and I/O interfacing.

UNIT 4 **Electromagnetics**

Electrostatics; Maxwell"s equations: differential and integral forms and their interpretation boundary conditions, wave equation, Poynting vector; Plane waves and properties: reflection and refraction, polarization, phase and group velocity, propagation through various media, skin depth; Transmission lines: equations, characteristic impedance, impedance matching, S-parameters, Smith chart; Waveguides: modes, boundary conditions, cut-off frequencies, Rader range equvation, Friss formula; Antennas: antenna types, radiation pattern, gain and directivity, return loss, antenna arrays; Wave Propagation, Antenna design considerations - Microstrip and Horn antennas. Basics of radar; Properties and characteristics of light sources {Laser and LED} and detectors; Light propagation in optical fibers.

UNIT 5 **Control Systems**

Basic control system components; Feedback principle; Transfer function; Block diagram representation; Signal flow graph; Transient and steady-state analysis of LTI systems; Frequency response; Routh-Hurwitz and Nyquist stability criteria; Bode and root-locus plots; Closed loop control system design by Nichols plot , PID controller design, Lag, lead and lag-lead compensation, States space models, states space equations and solutions, states space methods for controller designs and non-linear control systems and its applications.

UNIT 6 **Communications**

Random processes: autocorrelation and power spectral density, properties of white noise, filtering of random signals through LTI systems; Analog communications: amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, superheterodyne receivers, circuits for analog communications; Information theory: entropy, mutual information and channel capacity theorem. Digital communications: PCM, DPCM, digital modulation schemes, amplitude, phase and frequency shift keying {ASK, PSK, FSK}, QAM, MAP and ML decoding, matched filter receiver, calculation of bandwidth, SNR and BER for digital modulation; Fundamentals of error correction, Hamming codes; inter-symbol interference and its mitigation; Wireless Communication: Structure of a Wireless Communication Link, Modulation Techniques: QPSK, MSK, GMSK. Basics of TDMA, FDMA and CDMA.

Mode of Evaluation: 12 Quizzes with Multiple Choice Questions. Best 10 quizzes are considered for computing 100M. Student shall score atleast 80% in atleast 8 quizzes to be considered for grading

Course Outcomes:

The students will be able to

1. Apply knowledge of mathematics, science, and engineering
2. Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health care and safety, manufacturability, and sustainability

APPROVED IN:
BOS : 26-04-2021
SDG No. &
Statement: SDG
Justification:

ACADEMIC COUNCIL: 17-09-2021

BTEN1001	INTRODUCTION TO BIOTECHNOLOGY-I	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	Nil						
Co- requisite	Nil						
Preferable exposure	Nil						

Course Description:

This course introduces the student to the basics of biology such as classification, cell structure, biomolecular structure, metabolism, function

Course Educational Objectives:

- Introduce the cellular basis of life.
- Provide the basis for classification of living organisms.
- Describe the important biomolecules
- Describe the applications of biomaterials
- Describe the different metabolic pathways

UNIT 1 **6 hours**

Introduction to Biology, Cellular basis of life, differences between prokaryotes and eukaryotes. Classification based on carbon and energy sources, Tools of molecular taxonomy

UNIT 2 **8 hours**

Biomolecules, structure and functions of proteins, nucleic acids, lipids and sugars. Structure and function of hemoglobin, antibodies and enzymes. Industrial applications of enzymes

UNIT 3 **10 hours**

Bioenergetics, Respiration: Glycolysis and TCA cycle, Electron transport chain and oxidative phosphorylation. Anaerobic respiration and Fermentation and its industrial applications Mechanism of photosynthesis, Light and dark reactions

UNIT 4 **12 hours**

Genetics: Mendel's laws of inheritance. Gene interactions- Epistasis, Incomplete & Codominance, Multiple alleles, Additive, complementation, Pleiotropism. Linkage, Crossing over. Gene mapping. Cell cycle and regulation. Mitosis and Meiosis

UNIT 5 **14 hours**

Human physiology – Membrane transport- Active and passive. Cell signaling and communication. Neurons – structure, function and types. Synapse-types, neurotransmitters, transmission of nerve impulse. Neuromuscular junctions. Muscle- structure, function and types.

Textbooks:

1. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A global approach", Pearson Education Ltd, 2018.
2. Arthur T Johnson, Biology for Engineers, CRC press, 2011

References

1. Alberts et. al. The molecular biology of the cell, 6/e, Garland Science, 2014
2. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, "Outlines of Biochemistry", John Wiley and Sons, 2009.
3. John Enderle and Joseph Bronzino Introduction to Biomedical Engineering, 3/e, 2012.

Course Outcomes:

After the completion of the course the student should be able to

1. Explain classification of living organisms.
2. Explain cell as the basis of life
3. Explain the importance of various biomolecules
4. Summarize application of enzymes and fermentation in industry.
5. Analyze metabolic pathways

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1										2			3			
CO2											2		3			
CO3		2	2							1			2			
CO4	3									3				3		
CO5		3				1				3	1	1			3	

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">BTEN1021</td><td rowspan="2">INTRODUCTION TO BIOTECHNOLOGY-II</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">Nil</td></tr>
<tr><td>Co- requisite</td><td colspan="7">Nil</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Nil</td></tr>
</table>

Course Description:

This course introduces the student to the Applications of Biotechnology in plant , animal and industrial development

Course Educational Objectives:

1. Describe the concept of Central Dogma of Molecular Biology
2. Describe the transfer of genetic information.
3. Introduce recombinant DNA technology
4. Introduce the techniques used for modification of living organisms

UNIT 1 10 hours

Biotechnology: Concept, scope and importance. Origin of life-theories. Structure of bacterial, plant and animal cells-functions of cell organelles. Significance of biomolecules in biological systems

UNIT 2 12 hours

The central dogma of molecular biology. Concepts of genetic engineering, Restriction endonucleases, cloning vectors, methods of gene transfer. Polymerase Chain Reaction. Introduction to bioinformatics and biological databases

UNIT 3 12 hours

Biotechnology for Plant improvement: Strategies for engineering stress tolerance, transgenic plants. Micropropagation of novel varieties. Production of secondary metabolites and their importance. Molecular pharming.

UNIT 4 12 hours

Biotechnology for improvement of animals: Applications in animal husbandry, medicine and animal husbandry. Transgenic animals. Gene therapy and genetic counselling. Bioethics.

UNIT 5 14 hours

Industrial and Microbial Biotechnology: Overview of industrial fermentation process and products. Fermentation technology for production of Penicillin. Introduction to patents. Biotech industry in India and abroad.

Textbooks:

1. J.M. Walker and R. Rapley, Molecular Biology and Biotechnology, 5/e, Royal society of chemistry, 2009.
2. W. Godbey, An Introduction to Biotechnology, The Science, Technology nd Medical Applications, 1/e, Woodhead Publishing, 2014.

References

1. P.K. Gupta, Elements of Biotechnology, 2/e, Rastogi Publications, 2014.
2. B. Albert's, A. Johnson, J. Lewis, D. Morgan, M. Raff, K. Roberts and P.Walter, Molecular Biology of the Cell, 6/e, Garland Publishers, 2014.
3. H. Lodish, A. Berk, C. A. Kaiser, M. Krieger, A. Bretscher, H. Ploegh, Amon and M. P. Scott, Molecular Cell biology, 7/e, W.H Freeman and Company, 2014.

Course Outcomes:

After the completion of the course the student should be able to

1. Explain the scope and importance of biotechnology
2. Understand the application of biotechnology in transgenic plant development.
3. Understand the role of biotechnogy in animal husbandry and livestock improvement
4. Explain the potential of biotechnology in industry in strain improvement

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1									2			3			
CO2		2									2		3			
CO3			3							1			2			
CO4	3									3				3		
CO5		3				1				3	1	1			3	

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">FINA1031</td><td rowspan="2">PRINCIPLES AND PRACTICE OF BANKING</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">Nil</td></tr>
<tr><td>Co- requisite</td><td colspan="7">Nil</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Nil</td></tr>
</table>

Course Description:

The significance of the banking sector in India has been continuously upward for several decades. The sector is playing a role of a catalyst in the development of the economy. The Banks started playing a critical role in the social development process and became a partner in Government's welfare schemes and policies. Principles of and Practices of Banking course explores the fundamental principles and practices of banking and credit in India. It helps students to understand basics of banking and regulation to recent developments in Banking technology

Course Educational Objectives:

1. To understand the Indian financial system, role of commercial Banks, RBI in India and the regulations of Indian Banks.
2. To comprehend the banking Principles
3. To give the student adequate exposure to banking practice.
4. To acquaint and apply innovations in the banking sector.
5. To give an overall exposure to banking Principles and Practice.

UNIT 1 Banking System and Structure 9 Hours

Banking system and structure in India: Evolution of Indian Banks-Types of banks; Commercial Banks, Cooperative Banks, Role of RBI; Banking Regulation, Constitution, Objectives, Functions of RBI, Tools of Monetary control; Regulatory Restrictions on Lending. Types of Banking- Retail, Wholesale and International Banking.

UNIT 2 Risk management and Basel Accords 9 Hours

Introduction to Risk Management and Basel I, II &III Accords. Role and functions of CIBIL. Fair practices code for debt collection. Principles of Lending: Cardinal Principles, Non-fund-based limits, Credit appraisal Techniques. Cash management services and its importance.

UNIT 3 Functional Banks 9 Hours

Banker Customer Relationship: Types, Different Deposit Products & Services, Services to customers and Investors; PMLA Act; KYC Norms; Banker as lender: Types of loans, Overdraft facilities, Discounting of bills, Financing book Debts and supply bills- Charging of Security bills- pledge, mortgage

UNIT 4 Customer Protection 9 Hours

COPRA Act and its operational aspects; Banking Ombudsman Scheme; Role and duties Paying and collecting Banks; Banker Protection under Negotiable Instrument Act- Endorsement, Forged Instruments- Bouncing of Cheques and their implications; Operational aspects of opening and maintaining accounts of various types of account holders. Ancillary Services: Remittances & Safe Deposit lockers, Govt Business, EBT

UNIT 5 Banking Technology 9 Hours

Computer Systems: LAN,WAN, UPS, Core banking, Data warehousing, Data Mining. Digital Banking: ATMs, Electronic Kiosks-CDK, BNA, PBP; Cards – Types, Networks, Wallets; PPI. Electronic Banking – Internet & Mobile Banking. Trends In Communication Networks for Banking: EFT System, SWIFT, RTGS, NEFT, Automated Clearing System. Digital Payment Systems – NPCI

Textbooks:

1. Principles and Practices of Banking, IIFB, 5thEditionn 2021
2. Principles And Practices Of Banking (Paperback, N S TOOR & ARUNDEEP TOOR) 14th Edition

References:

1. Shekhar&Shekhar (2010),Banking Theory and Practice, New Delhi: Vikas Publishing House.
2. P.K. Srivastav(2011),Banking Theory and Practice, NewDelhi:Vikas Publishing House.
3. Sundaram& P.N. Varshney (2010), Banking Theory, Law and Practice, New Delhi:S.Chand& Co.
4. Padmalatha Suresh and Justin Paul (2013),Management of Banking and Financial Services, New Delhi: Pearson Education.

Journal(s):

1. GITAM Journal of Management, Visakhapatnam.
2. The Journal of Banking Studies, Mumbai.

Website(s):

1. https://www.icai.org/

Course Outcomes:

1. Student acquires knowledge about theoretical aspects of banking and
2. Student acquires knowledge about relationship between banker and customer
3. Student learns about the practicalities of banking and the latest trends in banking.
4. Students develops skills about legal aspects and negotiable instruments.
5. Student enhance knowledge about latest banking trends and technology.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	0	0	0	0	0							3	1	0
CO2	1	2	0	1	0	0							2	1	1
CO3	2	2	3	2	1	0							0	1	1
CO4	1	2	3	2	1	2							2	0	1
CO5	0	0	0	0	1	1									

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">HRMG1021</td><td rowspan="2">HUMAN RESOURCE MANAGEMENT</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">Nil</td></tr>
<tr><td>Co- requisite</td><td colspan="7">Nil</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Nil</td></tr>
</table>

Course Description:

Success in today's competitive business environment is increasingly a function of effective management of its resources, particularly human resources, which are the most valuable assets of an organization. The efficiency and quality of service of an organization depend on its employee's enthusiasm and satisfaction with their jobs, which are directly related to their sense of being treated fairly. To become a successful manager, it is imperative to understand human sensitivities and factors that motivate individuals. Human Resource Management course provides the basic tools required as an HR professional in an organization

Course Educational Objectives:

1. To Understand the fundamentals, evolution, function & challenges of HRM
2. To Explore the role of HRM in procurement, development of human resources
3. To Analyze the basic factors in designing the compensation and collective bargaining
4. To Evaluate safety and health and establish effective separation practices.

UNIT 1 Introduction 10 Hours

Introduction: Nature, scope and significance of HRM - Evolution of HRM – Recent trends in HRM – Functions of HRM – Challenges of HR managers.)

UNIT 2 Procurement 10 Hours

Procurement: Human Resource Planning – HR Forecasting methods - Job analysis and Job design – Recruitment - Selection – Induction.

UNIT 3 Development 10 Hours

Development: Identification of training needs - designing the training program – Methods of training – Difference between Training & Development.

UNIT 4 Compensation and Integration 10 Hours

Compensation and Integration: Introduction - Basic factors in determining pay rates – Basic, Supplementary and Executive Remuneration – types of employee benefits and services - Quality of work-life – Collective Bargaining.

UNIT 5 Separation and maintaining 10 Hours

Separation and Maintaining: Communication and Counseling - Safety and Health – Internal mobility - Retirement and Retirement benefits..

Textbooks:

1. Gary Dessler & Biju Varkkey, "Human Resource Management," Pearson, New Delhi, 16th edition.
2. George W Bohlander, Scott A Snell, "Principles of Human Resource Management," Cengage Learning, 2017.16th edition.
3. Aswathappa, K., Human Resource and Personnel Management: Text & Cases, TMGH
4. Subba Rao, P., Personnel and Human Resource Management (Text & Cases), Himalaya

References:

1. Edwin B Flippo, "Personnel Management," Tata McGraw Hill Publishing, New Delhi, 1984
2. John H. Bernardin, "Human Resource Management - An Experiential Approach," Tata McGraw Hill, New Delhi, 2013
3. Mirza, Saiyadain, "Human Resource Management," Tata McGraw Hill, New Delhi, 2013
4. Gary Dessler & Biju Varkkey, "Human Resource Management," Pearson, New Delhi, 2015 14th edition.

Journal(s):

- Harvard Business Review, Harvard Business School Publication USA
- People Matters Online Magazine
- Human Capital Magazine
- Vikalpa, Indian Institute of Management, Ahmedabad

Course Outcomes:

On successful completion of this course, students will be able to:

- Understanding the concept of HRM and its importance.
- Describe the process of workflow analysis and identify why it is essential to HRM.
- Understand the concepts of Training and Development
- List various factors determining pay rates.
- Analyze the role of the supervisor in employee safety and minimize accidents at the workplace.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	2	1	0	2						3	1	0
CO2	1	2	1	3	1	1	1						2	1	1
CO3	2	1	2	2	1	0	1						0	1	1
CO4	2	1	2	1	1	1	3						2	0	1
CO5	0	0	2	3	0										

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 8 Decent Work and Economic Growth

SDG Justification: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

<table>
<tr><td rowspan="2">MKTG3011</td><td rowspan="2">SALES AND DISTRIBUTION MANAGEMENT</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">Nil</td></tr>
<tr><td>Co- requisite</td><td colspan="7">Nil</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Nil</td></tr>
</table>

Course Description:

Sales Management focuses on the sales techniques and the management of the sales force. The success of any sales and marketing department lies in the effectiveness of the Sales Force. The goal of the Sales Management course is to examine the elements of an effective sales force as a key component of the organization's total marketing effort. A successful Sales Manager needs to understand the fundamentals of the sales process, the relationship between sales and marketing, sales force structure and issues in recruiting, selecting, training, motivating, compensating and retaining sales people.

Course Educational Objectives:

1. To understand the planning and staffing needs in professional sales
2. To learn how to manage and motivate a professional sales team as a Sales manager
3. To analyse the key success factors for sales executive performance.

UNIT 1

Introduction to Sales Management - Evolution of Sales Management, importance of Sales Management, types of Selling, difference between Selling and Marketing, Modern Day Sales Activities, Selling Skills, Selling Strategies, Selling Process.

UNIT 2

Sales Planning and Budgeting: Sales planning process, sales forecasting methods, sales budgeting process, methods used for deciding sales budget, types of quotas and quota setting procedure, reasons for establishing or revising sales territories, routing and scheduling sales persons, market cost analysis.

UNIT 3

Sales Force Management: Recruitment and selection of the sales force, training the sales force, sales force motivation, sales force compensation, sales force control and evaluation.

UNIT 4

Introduction to Distribution Management -Definition, need for Distribution Channels, designing the Marketing Channels, Motivating and Evaluating Channel Members, Capturing the Customer requirements

UNIT 5

Managing Distribution Channels - Managing Channel Information Systems, reasons for Channel Conflicts, Managing Conflict, Managing, Ethical issues in Sales and Distribution Management

Textbooks:

1. Krishna K Havaldar, Vasnt M Cavale, Sales and Distribution Management, 2nd edition, Tata Mcgraw Hill, 2011.

References:

1. Tapan K. Panda &Sunil Sahadev (2011), Sales and Distribution Management 2nd edition Oxford Press.
2. S.L. Gupta, M.K.Rampal (2009) Cases in Sales and Distribution Management, Himalaya Publication house.
3. K.Sridhara Bhat (2011) Sales and Distribution Management, 1st, Himalaya Publication house.
4. S.A.Chunawalla (2012) Sales and Distribution Management, 3rd edition, Himalaya Publication house.
5. Dinesh kumar (2012) Marketing Channels ,Oxford Press.
6. Richard R Still, Edward W Cundiff, Norman &A P Govoni(2011) Sales and Distribution Management, 5th edition, Pearson Publications.
7. Spiro Stanton & Rich (2010) Management of Sales Force, 13th edition, Tata McGraw Hill.
8. Prof. M.V. Kulkarni (2010) Sales and Distribution Management, Everest Publishing House.
9. Anne T Coughlan etal (2011), Marketing Channels, 7th edition, Pearson education.
10. Mark W Johnston, Greg W Marshall (2009), Sales Force Management, 9th edition, Tata McGraw Hill.
11. Dr.S.L.Guptha (2010), Sales and Distribution Management, 2nd edition, Excel books.
12. PingaliVenugopal (2012) Sales and Distribution Management, Sage Publications

Journal(s):

- Indian Journal of Marketing & Journal of Advertising Research
- GITAM Journal of Management, GITAM Institute of Management, GITAM Deemed to be university, Visakahapatnam
- Harvard Business Review, Harvard Business School Publication Co. USA
- Vikalpa, Indian Institute of Management, Ahmedabad

Course Outcomes:

On successful completion of this course, students will be able to:

1. Students would be able to understand the planning and staffing needs in professional sales.
2. Students would learn how to manage and motivate a professional sales team, as a sales manager.
3. Students would be able to analyze the key success factors for sales executive performance.
4. Students would learn how to manage and motivate distribution channel members.
5. Students can manage distribution channels and manage conflicts

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	2	1	0	2	0	0	0	0	1	3	1	0
CO2	1	2	1	3	1	1	1	0	0	0	0	1	2	1	1
CO3	2	1	2	2	1	0	1	0	0	0	0	1	0	1	1
CO4	2	1	2	1	1	1	3	0	0	0	0	1	2	0	1
CO5	0	0	2	3	0	1	1	0	0	0	0	1	1	1	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

Programme Core

EECE1051	ELECTRICAL WORKSHOP	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course is to familiarize the students with commonly used components, accessories and measuring equipment in Electrical installations. The course also provides hands on experience in setting up of simple wiring circuits and electric machine wiring.

Course Educational Objectives:

- Explain different tools and symbols used in electrical wiring.
- Impart the skills to do few varieties of electric wiring.
- Demonstrate different electrical machines and their wiring arrangement
- Train to operate various electrical machines.

List of Experiments:

1. Study of various electrical tools and symbols.
2. Identify different types of cables/wires and switches, fuses & fuse carriers, MCB and ELCB, MCCB with ratings and usage.
3. Wiring of light/fan circuit using two way/three way control (Staircase wiring)
4. Go-down wiring / Tunnel wiring
5. Wiring of power distribution arrangement using single phase MCB distribution board with ELCB, Main switch and Energy meter.
6. Measurement of voltage, current, resistance in DC circuit.
7. Measurement of voltage, current and power in single phase circuit using voltmeter, ammeter and wattmeter. Calculate the power factor of the circuit.
8. Wiring of backup power supply including inverter, battery and load for domestic installations.
9. Starting of DC shunt motor using three-point starter.
10. Starting of DC series motor using two-point starter.
11. Starting of single-phase induction motor.
12. Starting of three phase induction motor.

Text Books:

1. Sudhakar and ShyamMohan ,Network Theory, 2/e, TMH,2012.
2. Schaum's outline series, Basic circuit analysis, McGraw-Hill Professional,2012
3. A.Chakrabarti, Circuit Theory Analysis & Synthesis, 6/e, DhanpatRai and Company,2014.
4. Robert L Boylestad, Introductory Circuit Analysis,12/e, Pearson Publications,2013.

References:

1. William H. Hayt Jr., Jack E. Kemmerly, Engineering Circuit Analysis, 8/e, McGrawHill,2013

Course Outcomes:

1. Summarize supply arrangements and their limitations, knowledge of standard voltages and their tolerances, safety aspects of electrical systems and importance of protective measures in wiring systems (L2).
2. Explain types of wires, cables and other accessories used in wiring. Creating awareness of energy conservation in electrical systems (L1).
3. Demonstrate simple lighting circuits for domestic buildings, distinguish between light and power circuits (L3).
4. Derive electrical circuit parameters and current, voltage and power in a circuit (L2).
5. Explain with backup power supply in domestic installation (L1).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		2	1									2		
CO2	2		2	1									1		
CO3	3		3	1									1		
CO4	3		2	1									2		
CO5	3		3	2									1		

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE1021</td><td rowspan="2">SIGNALS AND SYSTEMS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>1</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">MATLAB, Transform Techniques</td></tr>
</table>

Course Description:

Signals contain information about the behaviour or nature of some phenomenon and are functions of one or more independent variables. A system processes the signal for producing desired behaviour. Signal processing plays an extremely important and continually growing role in areas of science and technology such as communications, aeronautics and astronautics, acoustics, seismology, biomedical engineering and speech processing. This course introduces the basic concepts and mathematical tools required for signal processing.

Course Educational Objectives:

- To explain the mathematical representation /classification of continuous-time and discrete-time signals and systems
- To provide an understanding of characterization of linear-time invariant systems using impulse response and convolution function
- To familiarize the application of Fourier series, Fourier transform and their properties to continuous-time and discrete time signals and systems
- To impart the knowledge of Laplace and Z-transform and their properties to analyse continuous-time and discrete-time signals respectively.

UNIT 1 Signals and Systems 8 hours

Signals and Systems: continuous-time and discrete-time signals, transformations of the independent variable, exponential and sinusoidal signals, the unit impulse and unit step functions, continuous-time and discrete-time systems, basic system properties

UNIT 2 Linear Time Invariant Systems 7 hours

Discrete-time LTI systems: the convolution sum, continuous time LTI systems: the convolution integral, properties of linear time-invariant systems

UNIT 3 Fourier analysis of Continuous Time Signals and Systems 9 hours

Fourier series representation of continuous time periodic signals, convergence of the Fourier series, properties of continuous-time Fourier series (CTFS). Representation of Aperiodic signals: the continuous-time Fourier transform (CTFT), the Fourier transform for periodic signals. properties of the continuous-time Fourier transform, systems characterized by linear constant-coefficient differential equations.

UNIT 4 Fourier analysis of Discrete Time Signals and Systems 9 hours

Representation of aperiodic signals: the discrete-time Fourier transform, properties of the discrete-time Fourier transform, the Fourier transform for periodic signals, systems characterized by linear constant-coefficient difference equations.

UNIT 5 Analysis of CT and DT signals using Laplace/Z-Transform 7 hours

The Laplace Transform: the region of convergence (roc) for Laplace transforms, the inverse Laplace transform, properties of the Laplace transform. The Z-Transform: The region of convergence for the z-transform, the inverse-z transform, properties of the z-transform.

Simulation Assignments

This course shall involve at least 5 simulation assignments based on (but not limited to)

a. Basics of MATLAB
b. Generation of Continuous Time signals and Discrete Time Sequences
c. Implementation of Continuous-Time and Discrete-Time Systems
d. Reconstruction of Continuous Time Periodic Signals from their Fourier Series Coefficients
e. Filtering and Fourier Transform Analysis of Continuous Time Signals

Textbooks:

1. Alan V. Oppenheim, S. Willsky with S.Hamid Nawab, Signals and Systems, 2/e, Pearson Education, 1997.

References:

1. Bhagawandas P. Lathi, Linear Signals and Systems, Oxford University Press, 2009.
2. Simon Haykin, Barry Van Veen, Signals and Systems, 2/e, Wiley Student Edition, 2007

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Describe the mathematical model of continuous - time/discrete - time signals and systems and perform mathematical operations on signals (L2)
2. Determine the output response of continuous time/ discrete time LTI system using convolution integral and convolution sum(L2).
3. Analyse the characteristics of linear – time invariant systems(L4).
4. Derive the frequency domain representation of signals and systems using transform techniques(L3).
5. Determine the output response of LTI systems using CTFT and DTFT (L2).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1										1		
CO2	3	2	1										2		
CO3	2	2	1										1		
CO4	2	1	2										1		
CO5	3	2	1										1		

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

EECE1061	ELECTRICAL CIRCUIT ANALYSIS	L	T	P	S	J	C
		2	1	2	0	0	4
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	EECE1001: Basic Electrical and Electronics Engineering						

Course Description:

This course is aimed to introduce the basic concepts of electric circuits which are needed for the circuit analysis and has potential applications in various subjects that include design and development. This is base course for subjects like electrical machines, power systems and power electronics. The students are provided with hands on experience in verification of various network theorems and evaluation of network parameters.

Course Educational Objectives:

- To familiarize various circuit elements, basic laws and theorems.
- To appraise the behaviour of RLC networks for DC excitation.
- To teach the concepts of sinusoidal steady state analysis and resonance.
- To familiarize concepts of magnetic coupling in coupled circuits.
- To acquire two-port network parameters and the relations between them.
- To solve three-phase balanced and Unbalanced circuits.

UNIT 1 Introduction 8 hours

Ohms law, Kirchhoff’s laws, series and parallel circuits, source transformations, delta– wye conversion, linearity and superposition theorem with simple examples, Thevenin’s and Norton’s theorem with simple examples, maximum power transfer theorem with simple examples, reciprocity theorem, Milliman’s theorem, mesh analysis and nodal analysis with simple examples, concepts of super node and super mesh.

UNIT 2 DC Transients 6 hours

source free response of RL, RC and RLC circuits, forced response of RL, RC and RLC for DC excitation.

UNIT 3 Sinusoidal steady-state analysis 8 hours

sinusoidal functions and complex functions, instantaneous power, average power, effective values of current and voltage, apparent power and power factor, complex power, concept of phasors, phasor relationships for RL, RC and RLC circuits and steady-state analysis of RL, RC and RLC circuits.

UNIT 4 Coupled circuits, Resonance and Two-port Networks 8 hours

Magnetically coupled circuits, mutual inductance, coupling coefficient, parallel resonance, series resonance, bandwidth, quality factor, two port networks, impedance parameters, admittance parameters, hybrid parameters and transmission parameters, relationships between parameters.

UNIT 5 Three Phase Circuits 6 hours

Voltage, current and power in star connected and delta connected 3-phase circuits (for balanced and unbalanced loads).

List of Experiments

2. Verification of Thevenin's and Norton's theorems.
3. Verification of superposition theorem and maximum power transfer theorem.
4. Verification of compensation theorem.
5. Verification of reciprocity, Milliman's theorems.
6. Locus diagrams of RL and RC series circuits.
7. Series and parallel resonance.
8. Determination of self, mutual inductances and coefficient of coupling.
9. Determination of Z and Y parameters.
10. Determination of transmission and hybrid parameters.
11. Measurement of reactive power for star and delta connected balanced loads.
12. Determination of time response of RL & RC network.
13. Determination of form factor of non sinusoidal waveform.

Textbooks:

1. William H. Hayt Jr., Jack E. Kemmerly, Engineering Circuit Analysis, 8/e, McGrawHill,2013
2. Van ValkenburgM.E, NetworkAnalysis, 3/e, Prentice Hall India, 2014.

References:

1. Sudhakar and ShyamMohan ,Network Theory, 2/e, TMH, 2012.
2. Schaum's outline series, Basic circuit analysis, McGraw-Hill Professional, 2012.
3. A.Chakrabarti, Circuit Theory Analysis & Synthesis, 6/e, DhanpatRai and Company, 2014.
4. Robert L Boylestad, Introductory Circuit Analysis,12/e, Pearson Publications, 2013.

Course Outcomes:

After the completion of this course, the students will be able to

1. Solve various electric circuits using basic laws and thermos(L3).
2. Examine the behavior of RC and RL networks for DC excitation(L4).

3. Calculate voltage, current, real power, reactive power and power factor in electric circuits with sinusoidal excitation(L3).
4. Apply concepts of coupled circuits, resonance and two port networks(L5).
5. Determine voltages, currents and their phase relation in balanced and unbalanced 3-phase circuits (L3).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1		2			1					2		
CO2	3	1	1		2			1					2		
CO3	3	1	1		2			1		1			2		
CO4	3	3	3		2			1		2			2		
CO5	3	3	3		4			2		1	1	1	2		

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

EECE1041	ELECTRONIC DEVICES AND AMPLIFIER CIRCUITS	L	T	P	S	J	C
		3	0	2	0	0	4
Pre-requisite	None						
Co-requisite	EECE1001: Basic Electrical and Electronics Engineering, EECE1031: Network Theory and Analysis						
Preferable exposure	SPICE						

Course Description:

This course familiarizes the student with structure, operation, modelling and design of semiconductor devices and circuits. Laboratory experiments of this course includes hardware experiments, SPICE simulations and end-to-end circuit design using EDA/PCB design software. Study of these basic circuits is helpful to train the student to design amplifier circuits, digital switches and balanced amplifiers

Course Educational Objectives:

- To introduce the physical construction of bipolar junction transistors (BJTs) and metal oxide field effect transistors (MOSFETs)
- To impart the knowledge on design and simulation of current mirror circuits
- To familiarize the analysis of the input impedance, output impedance, voltage gain and bandwidth of MOSFET amplifier configurations.
- To explain the analysis and design of differential amplifiers
- To expose the student to semiconductor technology evolution, amplifier design principles and circuit analysis techniques

UNIT 1 Bipolar Junction Transistors 8 hours

Bipolar Junction Transistors: device structure and physical operation, current-voltage characteristics, the BJT as an amplifier and as a switch, BJT circuits at dc, biasing in BJT amplifier circuits, small-signal operation and models.

UNIT 2 MOS Field-Effect Transistors 7 hours

Device structure and physical operation, current-voltage characteristics, MOSFET circuits at dc, the MOSFET as an amplifier and as a switch, biasing in MOS amplifier circuits, small signal operation and models.

UNIT 3 IC Design Philosophy 9 hours

IC Design Philosophy: comparison of the MOSFET and the BJT, IC biasing-current sources, current mirrors and current-steering circuits, current-mirror circuits with improved performance

UNIT 4 Single Stage MOSFET amplifiers 9 hours

Single Stage MOSFET Amplifiers: basic MOSFET amplifier configurations, MOSFET internal capacitances and high frequency model, frequency response of the CS amplifier, discrete circuit MOS Amplifiers

UNIT 5 Differential Amplifiers 7 hours

Differential Amplifiers: the MOS differential pair, small-signal operation of the MOS differential pair, other non-ideal characteristics of MOS differential amplifier, the MOS differential amplifier with active load.

Textbooks:

1. Adel S. Sedra, Kenneth C. Smith, Arun N. Chandorkar, Microelectronic Circuits, 6/e, Oxford University Press, 2013

References:

1. Behzad Razavi, Fundamentals of Microelectronics, 2/e, Wiley Student Edition, 2013
2. Robert L. Boylestad, Louis Nashelsky, Electronic Devices and Circuits Theory, 10/e, Pearson Education, 2009
3. Dharma Raj Cheruku, B T Krishna, Electronic Devices and Circuits, 2/e, Pearson Education, 2008

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Describe the device structure/physical operation, analyze BJT/MOSFET circuits using their large signal and small signal models.
2. Distinguish between discrete component circuit design and integrated circuit design and appreciate the relative merits and demerits of BJT and MOSFET devices.
3. Design current mirror circuits given the output resistance, voltage headroom and output current requirements.
4. Derive the low frequency and high frequency characteristics of common source, common gate, common drain amplifiers.
5. Analyze and design differential amplifier circuits for gain and linearity requirements.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1									3		
CO2	3	2	2	1									3		
CO3	3	3	1	1									3		
CO4	2	3	1	2									3		
CO5	3	2	2	2									2		

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 ACADEMIC COUNCIL:01-04-2022

SDG No. & Statement:

SDG Justification:

EECE2061	ELECTRO MAGNETIC FIELDS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	MATH1011: Several Variable Calculus						
Co-requisite	None						
Preferable exposure	MATLAB						

Course Description:

This course provides scientific, mathematical and engineering principles that enable the students to understand forces, fields, and waves. The students need to understand the fundamental principles and laws of electromagnetism to develop and implement better analog and digital electronic system that take into account electromagnetic wave propagation and radiation effects. This course is base for other subjects like Electrical circuits, Electrical Machines and Power system.

Course Educational Objectives:

- To introduce various concepts of vector calculus and coordinate systems.
- To expose different concepts of electrostatic, magneto static and time varying electromagnetic systems.
- To familiarize the concepts of conductors, and dielectrics.
- To impart the concepts of Magnetic materials, magnetic forces and inductance.
- To expose the students the ideas of electromagnetic waves.

UNIT 1 **Review of vector calculus & Static electric field** 8 hours

Vector addition, subtraction, components of vectors, scalar and vector multiplications, triple products, Vector differentiation, partial differentiation, integration, vector operator- del, gradient, divergence and curl, integral theorems of vectors, three orthogonal coordinate systems (rectangular, cylindrical and spherical), conversion of a vector from one coordinate system to another.
Static electric field: Coulomb's law, Electric field intensity, electrical field due to point charges, line, surface and volume charge distributions, electric flux, flux density, Gauss law and its applications, Absolute electric potential, potential difference, electric dipole- electric field and potential due to dipole, torque on a dipole, electrostatic energy and energy density.

UNIT 2 **Conductors, dielectrics and capacitance** **8 hours**

Behavior of conductors and dielectrics in an uniform electric field, current and current density, Ohm's law in point form, continuity equation, boundary conditions of perfect dielectric materials, permittivity of dielectric materials, capacitance of parallel plate and spherical capacitors, Poisson's and Laplace's equations in electric field and solution of Laplace's equation.

UNIT 3 Static Magnetic Fields, Magnetic Forces, Materials and Inductance 8 hours

Static Magnetic Fields: Biot-Savart law, Ampere law, magnetic flux and magnetic flux density, scalar and vector magnetic potentials. Steady magnetic fields produced by current carrying conductors.
Magnetic Forces, Materials and Inductance: force on a moving charge, force on a differential current element, force between differential current elements, nature of magnetic materials, magnetization and permeability, magnetic boundary conditions, self-inductance of solenoid and toroid, Neumann's formula for mutual inductance.

UNIT 4 Time Varying Fields and Maxwell's Equations 6 hours

Time Varying Fields and Maxwell's Equations: Faraday's laws of electromagnetic induction, static and motional electromotive forces, displacement current, point and integral forms of Maxwell equations, time varying fields.

UNIT 5 Time Varying Fields and Maxwell's Equations 6 hours

Electromagnetic waves: Derivation of wave equation, uniform plane waves, Maxwell's equation in phasor form, wave equation in phasor form, plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect, Poynting theorem

Textbooks:

1. A.Pramanik, Electromagnetism-Theory and Applications, PHI Learning Pvt. Ltd,2009.
2. A. Pramanik, Electromagnetism-Problems with Solution, Prentice Hall India,2012.

References:

1. M. N. O. Sadiku, Elements of Electromagnetics, Oxford University Publication, 2014.
2. W. Hayt, Engineering Electromagnetics, McGraw Hill Education, 2012.
3. Joseph Edminister,Vishnu Priye, Electromagnetics, Schaum's Outline Series, 2017.

Course Outcomes:

After the completion of this course, the students will be able to

1. Determine the electric fields for different geometric configurations(L3).
2. Calculate capacitance using Poisson's and Laplace equations(L3).
3. Determine the magnetic fields for different geometric configurations(L3).
4. Determine and solve the Maxwell's equations(L5).
5. Demonstrate wave propagation in different media(L2).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1		2		1	3					2		
CO2	3	2	1		2		1	1					3		
CO3	3	1	1		2		1	2		1			2		
CO4	3	3	3		2		1	1		3			3		
CO5	3	3	3		4		1	3		1	1	1	2		

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE 2021</td><td rowspan="2">DIGITAL LOGIC DESIGN</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

Digital Logic Design is an introductory course which provides the basic concepts involved in the design and analysis of digital circuits for computing systems. A digital circuit is constructed using basic building blocks: logic gates and flip-flops. This course deals with the design of various combinational and sequential circuits used to build more complex computing systems

Course Educational Objectives:

- To introduce number systems, conversion used for representing numbers in computational structures
- To familiarize the implementation of simple logical operations using Combinational circuits
- To acquaint the student with the design of combinational and sequential logic circuits with practical design examples
- To expose different types of memories used in digital systems
- To impart the design of synchronous and asynchronous digital systems
- To demonstrate the use of standard chips and PLDs in building digital computational structures

UNIT 1 Binary Systems and Logic Gates 10 hours

Binary Systems: digital systems, binary numbers, number base conversions, octal and hexadecimal numbers, complements, signed binary numbers, binary codes, binary logic. Boolean Algebra and Logic Gates: basic definitions, axiomatic definition of boolean algebra, basic theorems and properties of boolean algebra, boolean functions, canonical and standard forms, digital logic gates.

UNIT 2 Simplification of Boolean functions 10 hours

Simplification of Boolean functions: The map method, four-variable map, five-variable map, product of sums simplification, don’t-care conditions, NAND and NOR implementation, exclusive-OR function.

UNIT 3 Combinational Logic Circuit Design 6 hours

Combinational Logic: combinational circuits, analysis procedure, design procedure, binary adder-subtractor, decoders, encoders, multiplexers. Memories: random-access memory, memory decoding.

UNIT 4 Sequential Logic Circuit Design 9 hours

Synchronous Sequential Logic: sequential circuits, latches, flip-flops, analysis of clocked sequential circuits, state reduction and assignment, design procedure. Registers and Counters: registers, shift registers, ripple counters, synchronous counters, ring counter.

UNIT 5 Implementation of Digital Logic Circuits 5 hours

Transistors as Switches, NMOS Logic Gates, CMOS Logic Gates, MOS Implementation of static latches and flipflops. Programmable Logic Devices: Programmable Logic Array, Programmable Array Logic, Complex Programmable Logic Devices, Field Programmable Gate Arrays. FPGA Design Flow

List of Laboratory Experiments:

1. Verification of Truth Tables of Logic gates and implementation of Basic gates using Universal Gates
2. Implementation of the given Boolean functions using logic gates in both SOP and POS form.
3. Simplification of the given Boolean function using K-map and implement using logic gates.
4. Realization and verification of Full adder and Full Subtractor using logic gates.
5. Implementation of the given function using decoder and logic gates.
6. Implementation of the given function using Multiplexer and logic gates.
7. Verification of State Tables of SR, D, JK and T-Flip-Flops.
8. Verify the operation of Shift Registers using D flip-flops.
9. Design and verify the operation of 4-bit and Mod-N Ripple Counters using JK flipflops.
10. Verilog Modelling and Simulation of 1-bit full adder, 2 X 4 Decoder, Mod-13 Counter
11. Study of PLA, CPLD, FPGA Datasheets and appreciating their architectural highlights
12. FPGA Implementation of 1-bit full adder, 2 X 4 Decoder, 4-Bit Counter

Textbooks:

1. Michael D. Ciletti, M. Morris Mano, Digital Design, 5/e, Pearson Education, 2014
2. Adel S. Sedra, Kenneth C. Smith, Microelectronic Circuits, 7/e, Oxford University Press, 2013

References:

1. ZviKohavi, Switching and Finite Automata Theory, 2/e, Tata McGraw-Hill, 2008.
2. John F. Wakerly, Digital Design Principles and Practices, 4/e, Pearson Education, 2008.
3. Charles Roth, Jr., Larry Kinney, Fundamentals of Logic Design, 7/e, Cengage Learning, India, 2013.
4. Weste, Harris, CMOS VLSI Design, 4/e, Pearson Education, 2014.

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Convert any number into different base representations(L2).
2. Simplify logic expressions using Boolean laws and realize using basic and universal logic gates(L3).
3. Design combinational circuits for the given specifications(L4).
4. Design synchronous sequential circuits for the given specifications (L4)
5. Differentiate asynchronous and synchronous counters and implement Multiplexers and D flip flops using CMOS technologies (L3).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	1	3								2		
CO2	2	2	2	2	3								1		
CO3	2	2	3	2	3								2		
CO4	2	2	3	2	2								2		
CO5	3	2	2	1	3								2		

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE2031</td><td rowspan="2">ANALOG CIRCUITS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">EECE1041: Electronic Devices and Amplifier Circuits</td></tr>
</table>

Course Description:

This course equips the student with design principles of electronic system building blocks including feedback, oscillators, output stages, frequency selective filters, wave shaping circuits. Laboratory experiments of this course shall include hardware experiments, SPICE simulations and end-to-end circuit design using EDA/PCB design software. Skills learnt in this course shall help the student in improving existing circuits using negative feedback, building power Amplifiers, signal processing circuits etc.

Course Educational Objectives:

- To acquaint the students with the advantages and techniques of different negative feedback circuit configurations.
- To introduce the basic principles of oscillator circuits and design/simulate discrete component and op-amp oscillator circuits.
- To impart knowledge on analysis of the linearity, power efficiency and power dissipation of different output stages/power amplifiers
- To explain the basics and design of analog frequency selective filters using Butterworth and Chebyshev approximations
- To demonstrate the design of non-linear wave shaping circuits

UNIT 1 Feedback 8 hours

Feedback Amplifiers: The general feedback structure, properties of negative feedback, basic feedback topologies, the series-shunt feedback amplifier, the series-series feedback amplifier, shunt-shunt and shunt-series feedback amplifiers, determining loop gain.

UNIT 2 Oscillators 6 hours

Oscillators: Basic principles of sinusoidal oscillators, op amp RC oscillator circuits, LC and crystal oscillators.

UNIT 3 Output Stages and Power Amplifiers 7 hours

Output Stages and Power amplifiers: Classification of output stages, class A output stage, class B output stage, class AB output stage, power BJTs, class C output stage, MOS power transistor.

UNIT 4 **Analog Filter Design** **9 hours**

Filter Transmission, Types, and Specification, The Filter Transfer Function, Butterworth and Chebyshev Filters, First-Order and Second-Order Filter Functions, The Second-Order LCR Resonator. Active Filter Design

UNIT 5 **Multivibrator Circuits** **7 hours**

Bistable Multivibrators, Generation of Square and Triangular Waveforms Using Astable Multivibrators, Monostable Multivibrator, Integrated-Circuit Timers, NonlinearWaveform -Shaping Circuits

List of Laboratory Experiments:

1. Feedback Amplifier - calculation of gain, input resistance, output resistance with and without feedback, frequency response characteristic.
2. Design and Implementation of Two stage RC Coupled amplifier. 3.Oscillators (Colpitts, RC phase-shift, Wein-bridge)
4. Class A power amplifier.
5. Class B Push - pull power amplifier.
6. Tuned voltage amplifier.
7. Analysis and simulation of RC differentiator/integrator
8. Bistable/Monstable/Astable multivibrators with 555 timer
9. Operational Amplifier Circuits (Adders, Integrators, Differentiators, Filters).
10. Op-amp based AM/FM Modulator/Demodulator Circuits.
11. Data Converters
12. Active Filter Design

Text Books:

1. Adel S. Sedra, Kenneth C. Smith, Arun N. Chandorkar, Microelectronic Circuits, 6/e, Oxford University Press, 2013.
2. D Choudhury Roy, Shail B. Jain, Linear Integrated Circuits, New Age International, 2003.
3. Ramakanth Gayakward, Op-Amps and Linear Integrated Circuits, 4/e, Pearson Education, 2007.

References:

1. Behzad Razavi, Fundamentals of Microelectronics, 2/e, Wiley Student Edition, 2013.
2. R.F Coughlin, F.F Driscoll, Op-Amps and Linear Integrated Circuits, 6/e, Pearson Education, 2008.
3. S. Salivahanan, V.S. Kanchan Bhaskaran, Linear Integrated Circuits, Tata Mc- Graw Hill, 2008.
4. Sergio Franco, Design with Operational Amplifiers and Analog Integrated Circuits, 3/e, Tata Mc-Graw Hill, 2002.

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Analyse the characteristics of different negative feedback amplifier configurations (L4).
2. Choose and design negative feedback circuits to improve the characteristics of given open loop amplifier (L3).
3. Describe the basic principle of sinusoidal oscillators and identify the usage of different oscillator circuits (L1).
4. Design analog filters for the given design specification (L5).
5. Design different wave shaping circuits for signal processing applications

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	1	2	2								2		
CO2	3	3	2	3	2								3		
CO3	2	2	1	2	2								2		
CO4	3	3	1	3	2								2		
CO5	3	2	2	2	2								2		

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE2071</td><td rowspan="2">LINEAR CONTROL SYSTEMS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">MATH1021: Transform Techniques</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">MATLAB</td></tr>
</table>

Course Description:

This course is aimed to introduce linear mathematical modelling of different systems and their representation as open loop and closed loop systems. Output Response of developed mathematical models for different single input systems for standard test signals will be studied. Stability of system is assessed in with time-domain and frequency domain plots. Modern state space approach for modelling and analysis of multi-input and multi-output systems are introduced

Course Educational Objectives:

- To familiarize various concepts of block diagrams reduction techniques.
- To develop mathematical modelling of the system.
- To obtain response of single input systems for various test signals.
- To analyse stability of the system in time and frequency domains.
- To apply state variable analysis to multi-input and multi-output systems.

UNIT 1 Introduction 8 hours

Concepts of control systems. Different examples of control systems, Open loop and closed loop control systems and their differences. Block diagram representation of systems considering electrical systems as examples. Block diagram algebra. Representation by Signal flow graph, reduction using Mason’s gain formula, feedback Characteristics, Effects of feedback

UNIT 2 Introduction to mathematical modelling of physical systems 8 hours

Impulse response and transfer functions, equations of electrical networks, modeling of translational and rotational mechanical systems, time response of first and second order systems with standard input signals, Time domain specifications, steady state error and error constants.

UNIT 3 Concept of stability 8 hours

Routh-Hurwitz criterion, construction of Root locus, correlation between time and frequency responses, determination of frequency domain specifications, effects of P, PI, PD and PID Controllers.

UNIT 4 Stability of Control Systems 8 hours

Bode plots, Polar plots and Nyquist plots, all pass and minimum phase systems, numerical examples.

UNIT 5 State variable analysis 8 hours

State, State variables, State variable representation. Transfer function form to State variable form (Diagonal form), State variable form to transfer function form, transfer function form to canonical form.

List of Experiments:

1. Characteristics of series, parallel magnetic amplifier.
2. Design of PID controller for second order systems.
3. Time response of first and second order systems.
4. Frequency response for a lag compensating network.
5. Characteristics and transfer function of DC servo motor.
6. Characteristics and transfer function of AC servo motor.
7. Stepper motor control.
8. Frequency response for a lead compensating network.
9. Characteristics of self-saturated magnetic amplifier.
10. D.C Position control system.
11. Design of lag-lead compensator.
12. Step response and frequency response of a given plant

Textbooks:

1. Benjamin C.Kuo, Automatic Control Systems ,7/e , Prentice Hall of India, 1997.
2. M.Gopal, Control Systems Engineering , 3/e , Wiley Eastern Ltd., TMH, 2008.

References:

1. Ogata, Modern Control Engineering , 2/e, Prentice Hall of India., 2011
2. R.C. Sukla, Control Systems, 3/e, Dhanpatrai and Sons,1998

Course Outcomes:

Upon successful completion of the course the students will be able to

- Solve numerical on block diagrams reduction techniques (L3)
- Build the mathematical model of a given system (L3)
- Analyze the response of different order systems for various step inputs (L4)
- Analyze the stability of the system (L4)
- Able to comprehend solution of state equation (L5)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	3	2								3	2	2
CO2	3	3	1	2	3								3	2	2
CO3	3	3	1	3	3								2	1	2
CO4	2	2	1	2	2								3	2	2
CO5	3	2	2	2	2								3	1	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

EECE2081	DC MACHINES AND TRANSFORMERS	L	T	P	S	J	C
		2	0	2	0	0	3
Pre-requisite	EECE1001: Basic Electrical and Electronics Engineering						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course is aimed to introduce the principles and applications of dc machines and transformers. Construction, working and testing of dc Machines are discussed in detail. The students are provided with hands on experience in testing the performance of various types of DC machines and transformers.

Course Educational Objectives:

- To familiarize the basic concepts and analysis of magnetic circuits.
- To teach principles and working of dc Machines and transformers
- To demonstrate the performance and control of dc machines and transformers.
- To appraise the testing methods of dc machines and transformers.
- To focus on the applications of electrical machines in industry.

UNIT 1 **Magnetic Circuits** **6 hours**

Quantities, analysis of magnetic circuits- series, parallel, leakage flux, comparison of magnetic and electric circuits, review of Ampere's Law and Biot Savart law. BH curve of magnetic materials, flux- linkage vs current characteristic of magnetic circuits; linear and nonlinear magnetic circuits, energy stored in the magnetic circuit; force as a partial derivative of stored energy with respect to position of a moving element, torque as a partial derivative of stored energy with respect to angular position of a rotating element.

UNIT 2 **DC Generators** **8 hours**

Machine: magnetic structure - stator yoke, stator poles, pole- faces or shoes, air gap and armature core, commutator, armature winding and - lap and wave windings, operation of dc generator, emf equation, methods of excitations - separately and selfexcitations, armature reaction, compensating winding, commutation, methods of improving commutation, characteristics of dc generators, voltage build-up in a shunt generator, critical field resistance and critical speed, parallel operation.

UNIT 3 **DC Motors** **8 hours**

Operation of dc motors, back emf, torque equation, characteristics of different types of dc motors, starting methods, speed control methods, losses in dc machine, testing of dc machine - Swinburne's test, Hopkinson's test , load test, retardation test and field test.

UNIT 4 Single Phase Transformers 8 hours

Principle, construction and operation of single-phase transformers, emf equation, transformer on no load, and on load, equivalent circuit, phasor diagram, losses , efficiency and voltage regulation, all day efficiency. Testing - open circuit and short circuit tests, polarity test, backto- back test, separation of hysteresis and eddy current losses, Parallel operation of single-phase transformers.

UNIT 5 Three Phase Transformers 6 hours

Construction, types of connection and their comparative features, Scott connection, tapchanging transformers - no- load and on-load tap-changing of transformers, auto-transformers - construction, principle, applications and comparison with two winding transformers.

List of Experiments:

1. Open circuit characteristics (OCC) and external characteristics of separately excited dc Generator
2. Swinburne's test on a dc shunt motor.
3. OC and SC tests on single phase transformer.
4. Brake test on dc shunt motor
5. Load test on Single phase transformer.
6. Scott connection of transformers
7. Characteristics of dc series generator.
8. Characteristics of dc compound generator.
9. Separation of losses in dc shunt machine.
10. Speed control methods of dc shunt motor.
11. Hopkinson test.
12. Separation of losses in single phase transformer

Textbooks:

1. A.E. Fitzgerald, Charles Kingsley Jr. Stephen D. Umans, Electric Machinery, 7/e, McGraw Hill., 2013
2. I.J. Nagarath and D.P. Kothari, Electric Machines, 4/e, McGraw Hill,2010.

References:

1. A.E. Clayton and N.N.Hancock, Performance and Design of DC Machines, Oxford,1987
2. Chakrabarthy, Electrical Machines, 1/e, McGraw Hill,2013.
3. S.J. Chapman, Electric Machine Fundamentals, 5/e, McGraw Hill,2011

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Summarize principles, laws, and working of dc machines
2. Analyze the characteristics and application of various types of dc generators
3. Analyze the construction, characteristics and application of various type of dc motors and testing of motors
4. Explain the working of 1- phase and 3- phase transformers
5. Apply the principles of 3 phase transformer to multi-phase transformer

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	3								2		2
CO2	2	2	2	1	2								3		1
CO3	2	3	2	2	2								2		1
CO4	3	3	1	2	3								3		2
CO5	2	2	1	1	2								2		1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE2191</td><td rowspan="2">FUNDAMENTALS OF AUTONOMOUS VEHICLES</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

An autonomous vehicle, or a driverless vehicle, is one that is able to operate itself and perform necessary functions without any human intervention. Autonomous vehicles operate by using remote-sensing technology including radar, GPS, cameras, and lidar to monitor and create a 3-D map of their environment. These vehicles are used extensively in ground, aerial and underwater scenarios. This course provides the fundamental principles and applications of autonomous vehicles.

Course Objectives:

- To expose the student to the functions, architecture and applications of unmanned vehicles in ground, aerial and underwater applications.
- To impart the knowledge of different sensors and actuators used as part of autonomous vehicles
- To acquaint the students with principles of navigation and control of ground vehicles
- To impart the principles, operation and dynamics of quadrotor used in aerial vehicles
- To present the principles and case studies in the design of underwater vehicles

Unit I: Introduction **5 hrs**

Past, present and future of autonomous vehicles and types of autonomy. Introduction to Unmanned land vehicles, Unmanned Aerial Vehicles (UAVs) and Under Water Vehicles (UWVs). Types of autonomous vehicles and overall architecture.

Unit II: Sensors and actuators for AVs **10 hrs**

Principles and working of: Infrared sensors, ultrasound sensors, radars, lidars, inertial sensors (accelerometers and gyros), cameras. Principles and working of dc motors, servos and brushless DC motors. Fundamentals of electrical drives circuits, PWM control, electronic speed control.

Unit III: Unmanned autonomous ground vehicles **10 hrs**

Introduction to Ackerman’s model, planning and navigation, control systems and systems integration for a basic autonomous ground vehicle.

Unit IV: Unmanned aerial vehicles **10hrs**

Principle and operation of a quadrotor. Lateral and longitudinal dynamics of a quadrotor. Basic navigation and control for UAV.

Unit V: Unmanned under-water vehicles (UWVs) 10 hrs

SNAME notation for marine vehicles, basic dynamics of UWV, navigation in under water, case study on UWV for mine detection.

Text Book(s):

1. Ozguner, U., Acarman, T. and Redmill, K.A., 2011. Autonomous ground vehicles. Artech House.
2. Klancar, G., Zdesar, A., Blazic, S. and Skrjanc, I., 2017. Wheeled mobile robotics: from fundamentals towards autonomous systems. Butterworth-Heinemann.
3. Fahlstrom, P.G., Gleason, T.J. and Sadraey, M.H., 2022. Introduction to UAV systems.
4. John Wiley & Sons.
5. Fossen, T.I., 1999. Guidance and Control of Ocean Vehicles. Wiley.

Reference Book:

1. Burgard, W., Fox, D. and Thrun, S., 2005. Probabilistic robotics. The MIT Press.

Course Outcomes:

Upon successful completion of the course, student will be able to

- Elaborate the functions, architecture and applications of unmanned vehicles in ground, aerial and underwater applications.
- Present the specifications, operation, usage of different sensors and actuators used as part of autonomous vehicles
- Describe the principles of navigation and control of ground vehicles
- Analyze the dynamics of quadrotor used in aerial vehicles
- Present case studies and design issues in the design of underwater vehicles

<table>
<tr><td rowspan="2">EECE3061</td><td rowspan="2">ELECTRICAL MEASUREMENTS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">EECE1001: Basic Electrical and Electronics Engineering</td></tr>
</table>

Course Description:

This subject deals with analog and digital measuring instruments. It signifies measurement of resistance, inductance, and capacitance by using bridge circuits and calibration of meters. It acts as a base course for Electrical machines, Electrical power systems and power electronics etc.

Course Educational Objectives:

- Introduce students to various secondary instruments.
- Train students about various bridges.
- Acquaint various meters and its construction
- Classify instrument transformers and its testing
- Apply knowledge to design and create novel products.

UNIT 1 Indicating Instruments 8 hours

Principle, different types of control and damping arrangements in indicating instruments, Permanent Magnet Moving Coil (PMMC), Moving Iron (MI), electrostatic and dynamometer type meters, errors in indicating instruments, extension of instrument range for ammeters and voltmeters.

UNIT 2 Measuring instruments 8 hours

Dynamometer type wattmeter, errors and compensation, 3-phase power measurement by two wattmeter method, single phase energy meters, single phase induction type energy meter, errors and compensation. Calibration of wattmeter and energy meter. Frequency meters: Mechanical and electrical resonance type. Power factor meters: Dynamometer type, Moving Iron (MI) type.

UNIT 3 Bridges 8 hours

Measurement of resistance using Wheatstone bridge, Kelvin double bridge and megger. LCR meter Measurement of inductance using Maxwell’s bridge, Hay’s bridge and Anderson’s bridge. Measurement of capacitance using Schering bridge.

UNIT 4 Potentiometers 8 hours

General principle, Vernier dial, principle of standardization. AC potentiometers coordinate type and polar type, application of DC and AC potentiometers. Display devices: CRT display, DSO, Digital Multi meter.

UNIT 5 **Instrument Transformers** **8 hours**

Components and working of Current Transformer (C.T.), phasor diagram, ratio error and phase angle error, testing. Components and working of Potential Transformer (P.T.), phasor diagram, ratio error and phase angle error, testing.

List of Experiments:

1. Measurement of very low resistance using Kelvin's double bridge.
2. Measurement of medium resistance using Wheatstone's bridge.
3. Measurement of self-inductance using Maxwell's bridge.
4. Measurement of self-inductance in terms of capacitance using Anderson's bridge.
5. Measurement of capacitance power factor using Schering Bridge.
6. Measurement of capacitance using Wien's bridge.
7. Calibration of Energy meter by Phantom loading
8. Calibration of Wattmeter
9. Finding parameters of Choke Coil
10. Measurement of mutual inductance
11. Measurement of 3-phase power using 2-Wattmeter method

Textbooks:

1. A.K. Sawhney, "A Course in Electrical and Electronic Measurement and Instrumentation", 19/e, Dhanpat Rai and Sons,2011.
2. E.W. Golding and F.C. Widdis, "Electrical Measurements and Measuring Instruments" ,5/e, Wheeler Publications,1991

References:

1. Rajendra Prasad., "Electronic Measurements and Instrumentation", 4/e, Khanna Publishers, 2012
2. Harris F.K., "Electrical Measurements", John Wiley Publishers, 1974.
3. U.A. Bakshi, A.V. Bakshi,"Electrical measurements and instrumentation, Technical publications, 2009.

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Determine dynamo meter type measuring instruments. (L5)
2. Analyze to balance Bridges to find unknown values. (L4)
3. Determine use the potentiometer and skills for electrical projects. (L5)
4. Solve CT and PT ratios. (L6)
5. Simplify measurement of R, L, C ,Voltage, Current, Power factor , Power, Energy . (L4)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	3	2							2		1
CO2	2	3	1	1	3	2							3		1
CO3	2	3	2	1	2	3							3		2
CO4	3	3	1	1	3	2							3		1
CO5	2	3	1	2	2	2							2		1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE3071</td><td rowspan="2">AC MACHINES</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">EECE1001: Basic Electrical and Electronics Engineering, EECE1061: Electrical Circuit Analysis</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course is aimed to introduce to students the principles and applications of electrical alternating machines which are gaining importance in industries. Induction motors are used to meet the demand of the several industrial and commercial applications. Alternators are very widely used machine for generating bulk of electricity worldwide. Synchronous motors are used in all industrial applications where constant speed is necessary. This course is base to power electronic drives, power system stability and power system operation and control.

Course Educational Objectives:

- To study principles of AC machines and how they work.
- To familiarize various types of induction motors, synchronous motors.
- To acquaint the performance and control of AC machines
- To demonstrate the various types of single phase and special machines
- To expose the significance of AC machines for industries

UNIT 1 Induction Motors 8 hours

Types and constructional features of poly phase induction motors, principle of operation, three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field phasor diagram, slip, torque equation, torque characteristics, equivalent circuit, power stages, Methods of starting and speed control for induction motors.

UNIT 2 Testing of Induction motors and Single-phase induction motors 8 hours

No load and Rotor blocked tests, circle diagram. Cogging, crawling. Double cage rotor. Double revolving field theory, starting methods -Split phase type, capacitor start and capacitor run, shaded pole types, equivalent circuit based on double revolving field theory, universal motor, stepper motor, reluctance motor.

UNIT 3 Alternators 8 hours

Types and constructional features. Air-gap MMF distribution with fixed current through winding-concentrated and distributed. emf Equation, distribution factor, pitch factor. Effect of harmonics on EMF equation. Regulation of alternators on load. Parallel operation of alternators.

UNIT 4 Determination of regulation characteristics and Salient Pole Alternators 8 hours

Synchronous impedance method, MMF method, Zero power factor method (ZPF Method). Basic ideas of two reaction theory. Direct and quadrature axis reactance and their determination. Phasor diagram and regulation of salient pole alternators. Expression for power developed as a function of torque angle.

UNIT 5 Synchronous motors 8 hours

Constructional features and working of synchronous motors, synchronous machines on infinite bus bars. Phasor diagram. Starting methods. Synchronization, V and inverted V curves. Current and Power circle diagrams. Hunting and its suppression. Synchronous condenser.

List of Experiments:

1. No load and blocked rotor test on three phase Slip ring induction motor
2. No load and blocked rotor test on three phase Squirrel cage induction motor
3. No load and blocked rotor test on Single phase induction motor
4. Regulation of alternator by Synchronous impedance method
5. 5.V and inverted V curves of Synchronous motor
6. Load test on three phase Slip ring induction motor
7. Load test on three phase Squirrel Cage induction motor
8. Load test on single phase Induction Motor
9. Regulation of alternator by Zero Power Factor(ZPF) method
10. Speed control of three phase Squirrel cage induction motor by frequency control(V/f) method
11. Speed control of three phase Slip ring induction motor by rotor resistance control method
12. Slip test on three phase Synchronous machine

Textbooks:

1. M.G. Say, “Performance and design of AC Machines”, 3/e, ELBS, 2002.
2. I.J. Nagarath and D.P.Kothari, “Electrical Machines”, 4/e, McGraw Hill, 2010.

References:

1. Atkins; Chapman, “General Theory of Electrical Machines”, 8/e, McGraw Hill, 1979.
2. Fitzgerald A.E. & Kingsley, “Electrical Machinery”, 7/e, McGraw Hill, 2013.
3. George McPherson, Robert D. Laramore, “An Introduction to Electrical Machines and Transformers”, 2/e, Wiley, 2014

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Explain the constructional details, principle of operation of induction motor(L3) Describe different tests for calculating the performance parameters of three phase induction motors (L2)
2. Examine the starting and running performance of single-phase induction motor and
3. revolving field theory. (L3)
4. Analyse the performance of ac machines. (L4)
5. Describe the principle of operation of synchronous motor and different applications. (L3)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	3	2							2		3
CO2	3	2	1	2	2	2							2		2
CO3	3	3	2	2	3	3							2		3
CO4	2	3	2	1	2	3							3		2
CO5	3	2	1	2	3	3							2		2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE3081</td><td rowspan="2">ELECTRICAL POWER SYSTEM GENERATION, TRANSMISSION AND DISTRIBUTION</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

In this course it is aimed to introduce to the students the working principles of various power generating sources and detail analysis of faults occurrences in practical power systems. The basic concepts of solar energy, wind energy, biomass energy, geothermal energy and ocean energy are explained. Transmission line modelling parameters, fault conditions and mechanical conditions of transmission lines are analysed.

Course Educational Objectives:

- Study various basic concepts of conventional power sources, power grids and microgrids.
- Expose various basic concepts of renewable energy sources
- Familiarize various parameters in transmission lines
- Interpret the effect of sag and usage of underground cables
- Expose various AC and DC distributions systems

UNIT 1 Conventional Power Generation 8 hours

Hydroelectric Power Generation: Plant layout, working of hydroelectric power plant and selection of site. Thermal Power Generation: Plant layout, working of thermal power plant and selection of site. Nuclear Power Generation: Plant layout, working of nuclear power plant and selection of site.

UNIT 2 Renewable Energy Sources 8 hours

Solar Power Generation: Physical principles of conversion of solar radiation into heat, working principle of Flat plate collectors and Photovoltaic Cell.

Wind power generation: Basic components of Wind energy conversion systems, working principle of HAWT and VAWT.

Energy from Biomass: Biomass conversion technologies, working principle of Floating drum and fixed dome plants.

Geothermal energy: Working principle of Vapor and Liquid dominated systems

Energy from Oceans: Working principle of closed cycle OTEC. Basic components of Tidal power plant

UNIT 3 Transmission line Parameters 10 hours

Overhead Transmission Lines: Capacitance and Inductance calculations for single phase two wire line, three phase lines, proximity effect, skin effect. Sinusoidal Steady state representation of Lines: Short, medium and long lines, Characteristics of transmission lines. Surge Impedance Loading

UNIT 4 Mechanical design of overhead lines 8 hours

Sag and insulators: Line supports, insulators, voltage distribution in suspension-type insulators. Testing of insulators, String efficiency, tension and sag calculation, effects of wind and ice loading.
Underground cables: Comparison with overhead line. Types of cables, Insulation resistance, potential gradient, Capacitance of single core cables.
Corona: Formation of corona. Critical voltages, effect on line performance

UNIT 5 Distribution Systems 8 hours

Overview of Distribution systems, Types of DC & AC Distributors: Radial, and Ring systems. Voltage drop calculation with concentrated loads and uniformly distributed loads.

Textbooks:

1. S. N. Singh, “Electric Power Generation, Transmission and Distribution”, PHI Learning,2010
2. GD Rai, “Non-conventional Energy sources”,4/e,Khannapublishers,2012.
3. J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw HillEducation,1994

References:

1. O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education,1995
2. Gerald B Sheble, Bruce F Wollenberg Allen J Wood, “Power Generation, Operation, and Control”, 3/e, Wiley Interscience,2010"
3. R. Bergen and V. Vittal, “Power System Analysis”, Pearson Education Inc.,1999
4. D. P. Kothari and I. J. Nagrath, “Modern Power System Analysis”, McGraw Hill Education,2003
5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “Electric Power Systems”, Wiley, 2012

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Correlate various conventional power sources, power grids and microgrids.
2. Identify various renewable energy sources for power generation
3. Estimate the various parameters in transmission lines
4. Appraise the effect of sag on transmission lines
5. Assess various AC and DC distribution systems for concentrated and uniformly distributed loads

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	2	3						3	1	3
CO2	3	2	3	3	2	3	2						2	1	2
CO3	2	2	3	3	3	3	3						2	2	2
CO4	2	2	3	3	2	2	2						2	1	3
CO5	3	1	3	3	3	2	3						2	1	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE3041</td><td rowspan="2">MICROPROCESSORS AND MICROCONTROLLERS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">EECE2021: Digital Logic Design</td></tr>
</table>

Course Description:

Electronic gadgets became part and parcel of a common man these days. Microcontroller is an essential heart of any electronic gadget. It is the device which is responsible for the operation the gadget whatever may be the application of use. Microprocessor is that component which drives the microcontroller. Essential features of the microprocessor as well as the microcontroller are introduced in this course. Interfacing this controller with many a number of peripherals is also treated elaborately

Course Educational Objectives:

- To familiarize the concepts and architecture of 16 bit microprocessor 8086
- To explain assembly language programming of 8086 microprocessor
- To demonstrate the architecture, instruction set and programming of 8051 microcontroller
- To impart the knowledge of C programming to interface various peripherals like data converters, timers, serial port etc
- To demonstrate microcontroller based embedded system

UNIT 1 — 8086 Architecture — 8 hours

The Processor 8086: Register organization of 8086, architecture of 8086, signal description of 8086, physical memory organization, I/O addressing capability.

UNIT 2 — Instruction Set and Interrupts — 7 hours

Instruction Set and Interrupts: Addressing modes of 8086, instruction set of 8086, assembly language programs (example programs), interrupts and interrupt service routines, interrupt cycle of 8086, non-maskable interrupt, maskable interrupt (INTR).

UNIT 3 — 8051 Microcontroller — 5 hours

Introduction to Microcontroller 8051: Intel family of 8 bit microcontrollers, architecture, signal description, register set of 8051, important operational features of 8051, program status word (PSW).

UNIT 4 — Programming 8051 Timers and Serial Ports — 9 hours

Programming 8051 Timers and Serial Port: Basic registers of timer, modes of operation, programming timers in C (examples), Basics of serial communication, baud rate in 8051, SBUF, SCON, serial port programming in C (examples).

UNIT 5 Interfacing 8051 with ADC/DAC 8 hours

Interfacing of Peripherals to 8051: ADC 0808/0809 chip with 8 analog channels, programming ADC 0808/0809 in C, DAC interfacing DAC 0808, programming DAC in C. Introduction to ARM Processor: The ARM family history, ARM family variations.

List of Experiments:

Experiments with Microprocessor 8086 using Assembler:

1. Arithmetic operations on 8 bit and 16 bit operands.
2. Transfer block of data from one memory location to another memory location.
3. Programs using monitor routines.
4. Compute maximum, minimum and sorting (ascending and descending).
5. Generate Fibonacci series, average of N numbers and factorial of N.

Experiments with Microcontroller 8051 using Keil-C51:

1. Arithmetic operations on 8051.
2. Transfer given string serially with suitable baud rate.
3. Generation of waveforms using timers of 8051.
4. Interface DAC with 8051 to generate waveforms.
5. Interface ADC with 8051 to read analog data and display read data.

Simulation Experiments with ARM Development System

1. Demonstration of ARM Development System and Tools
2. Basic Experiments involving memory and I/O interfacing

Textbooks:

1. AK Ray, KM Bhurchandi, Advanced Microprocessors and Peripherals, 2/e,Tata McGraw Hill Publications, 2009.
2. Muhammad Ali Mazidi, Janice Gillispie, Mazidi, Rolin D. Mc Kinlay, The 8051 Microcontroller and Embedded Systems using Assembly and C, Second Edition, Pearson Education, 2002
3. Muhammad Ali Mazidi, Sarmad Naimi, SepehrNaimi, Janice Mazidi, ARM Assembly Language Programming &Architecture, Pearson Education, 2002

References:

1. Barry B. Brey, The Intel Microprocessors: Architecture, Programming and Interfacing, 8/e, Pearson Education, 2008.
2. Kenneth J. Ayala, 8086 Micro Processor: Programming and Interfacing the PC, 1/e, Delmar Cengage Learning, 2007.
3. Douglas V Hall, Microprocessors and Interfacing: Programming and Hardware, 2/e, Tata Mc Graw Hill, 2006.

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Summarize the concepts of architecture, instruction set and addressing modes of 8086 microprocessor (L2).
2. Develop programs of 8086 microprocessor to perform various tasks and verify the programs with 8086 kits (L3).
3. Differentiate between microprocessor and microcontroller and understand the basics of 8051 microcontroller and perform experiments with microcontroller 8051 using Keil- C51 (L4).
4. Interpret the interfacing of microcontroller with different peripheral devices such as timers, serial port, ADC and DAC etc. and verifying it practically using trainer kits (L3).
5. Identify the architectural highlights of ARM processors (L4).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2								2	2	3
CO2	2	3	2	3	3								3	2	3
CO3	2	2	3	3	2								2	2	3
CO4	3	2	2	3	2								2	2	2
CO5	3	3	2	2	3								2	3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE3091</td><td rowspan="2">POWER SYSTEM ANALYSIS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>1</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">EECE3081: Electrical Power Generation Transmission and Distribution</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

After completing this course the student will be acquainted with problems faced in power system like fault analysis, load flows, stability etc., and solution methods that are traditionally used to solve power system problems. The course equips the student with the control methods of frequency and voltage in power systems. Also the course introduces the advanced topics like SCADA, basic pricing principle of electricity market and demand side management.

Course Educational Objectives:

- Introduce various short circuit faults that occur in power systems.
- Acquaint the power system network using load flows and symmetric faults.
- Study the mathematical solution methods to power system problems.
- Familiarize the concept of control of frequency and voltage.
- Import monitoring and economic management methods.

UNIT 1 Fault Analysis 10 hours

Symmetrical faults: Three phase short circuit of unloaded alternator. Sub-transient, transient and steady state reactance of alternator. Symmetrical short circuit currents.
Unsymmetrical Faults: symmetrical components theory. Line to ground, line to line and line to line to ground faults. Problem solving. Fault calculations using Z-bus matrix.

UNIT 2 Power Flow Solutions 8 hours

Bus admittance matrix. Load flow studies, Gauss-Seidel Newton-Raphson, Decoupled and Fast decoupled methods of load flow analysis. Comparison of load flow methods.

UNIT 3 Stability of Synchronous Grid 10 hours

Swing Equations of a synchronous machine connected to an infinite bus. Power angle curve. Description of the phenomena of loss of synchronism in a single-machine infinite bus system following a disturbance like a three-phase fault. Analysis using Equal Area Criterion and numerical methods (Euler and Runge-Kutta 4th order).Impact of stability constraints on Power System Operation. Effect of generation rescheduling and series compensation of transmission lines on stability

UNIT 4 Control of frequency and Voltage 8 hours

Turbines and Speed-Governors. Frequency dependence of loads. Droop Control and Power Sharing. Automatic Generation Control.Generation and absorption of reactive power by various components of a Power System. Excitation System Control in synchronous generators, Automatic Voltage Regulator. Shunt Compensators, Static VAR compensators and STATCOM. Tap-Changing Transformer.

UNIT 5 Monitoring, Economics and Management 8 hours

Overview of Energy Control Centre Functions: SCADA systems. Phasor Measurement Units and Wide-Area Measurement Systems. Basic Pricing Principles: Generator Cost Curves, Utility Functions, Power Exchanges, Spot Pricing. Electricity Market Models (Vertically Integrated, Purchasing Agency, Whole-sale competition, Retail Competition), Demand Sidemanagement, Transmission and Distributions charges, Ancillary Services. Regulatory framework.

Textbooks:

1. J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education, 1994.
2. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “Electric Power Systems”, Wiley, 2012.

References:

1. O I Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education, 1995.
2. A R. Bergen and V. Vittal, “Power System Analysis”, Pearson Education Inc., 1999.
3. D. P. Kothari and I. J. Nagrath, “Modern Power System Analysis”, McGraw Hill Education.

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Acquired the knowledge of various short circuit faults in power systems.
2. Enabled to do load flow studies using different numerical methods.
3. Familiar with swing equation and its solution methods.
4. Operate and Control techniques and compensation required in power system.
5. Create awareness of automation and deregulation of power systems.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	3	2		3						2		3
CO2	3	3	2	3	3		3						3		2
CO3	2	2	2	3	3		2						2		3
CO4	3	3	3	2	2		3						3		2
CO5	2	3	3	3	2		3						3		3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

EECE3101	POWER ELECTRONICS	L	T	P	S	J	C
		2	0	2	0	0	3
Pre-requisite	EECE1061: Electrical Circuit Analysis						
Co-requisite	None						
Preferable exposure	EECE3081: Electrical Power Generation Transmission and Distribution, EECE1041: Electronic Devices and Amplifier Circuits						

Course Description:

Power Electronics deals with power conversion from mW to MW using Semiconductor devices (Diode, Thyristor, MOSFET, IGBT etc.). Power Electronics can be used in various fields such as Aerospace, Automotive electrical and electronic systems, industrial, residential, telecommunication, transportation, utility systems, etc. this is base course like Advanced power electronics and Electrical Drives and Control.

Course Educational Objectives:

- To impart knowledge about various power semiconductor devices.
- To introduce knowledge on the basic theory of power semiconductor devices and their practical applications in power electronics.
- To familiarize students to the principle of operation, design and synthesis of different power conversion circuits and their applications.
- To expose strong foundation for further study of power electronic circuits and systems.
- To train the students to analyze and design different power converter circuits.

UNIT 1 Power semiconductor switches and SCR 9 hours

Power diodes, power transistors, power MOSFET, IGBT,GTO, SCR, Thyristor family, two transistor model of SCR, static and dynamic characteristics, turn-on and turn-off methods, Gate characteristics, series and parallel operation of thyristors, Gate triggering circuits, Thyristor ratings, Protection circuits of SCR.

UNIT 2 Phase controlled rectifiers 8 hours

Single phase and three phases – half wave, semi converter, full-wave controlled rectifiers, dual converters, effect of load and source inductances. Natural commutation forced commutation circuits- Self, impulse, resonant pulse, complimentary and external pulse commutation.

UNIT 3 Choppers 8 hours

Principle of operation, step down choppers, step up choppers, Analysis of first quadrant chopper- Derivation of average load voltage, load current for continuous/discontinuous current operation, Morgan, Jones and Oscillation choppers.

UNIT 4 Inverters 9 hours

Series and parallel inverters, 1-phase and 3- phase inverters, McMurray inverter, McMurray Bedford inverter, Voltage control in inverters, Methods of harmonic reduction, Current source inverters.

UNIT 5 AC to AC Converters 9 hours

Principle of operation of cycloconverter, 1-phase to 1-phase cycloconverter, 3-phase to 1-phase cycloconverter, 3-phase to 3-phase cycloconverter, 1- phase and 3- phase voltage controllers using thyristors and triacs, AC choppers.

List of Experiments:
1. Static or V-I characteristics of SCR. Find IL and IH.
2. UJT Relaxation Oscillator.
3. 1-phase half-controlled rectifier with R and RL Load.
4. MOSFET based step up/ step down chopper.
5. Tuned voltage amplifier.
6. 1-phase AC voltage controller using TRIAC.
7. Voltage commutation
8. 3-phase Fully controlled Rectifier
9. 1-phase Dual converter.
10. 3-phase IGBT based PWM Inverter.
11. 1-phase Cyclo-converter
12. Complementary Commutation.
13. 3-phase VVVF PWM Inverter

Textbooks:
1. R.Ramshaw, “Power Electronics”, 1/e, John Wiley, 1973.
2. Muhammad H Rashid, “Power Electronics”, 2/e, Pearson Education, 2003.

References:
1. M D Singh, K B Khanchandani, “Power Electronics”, 3/e, Tata MC Graw Hill, 2008.
2. P.S. Bhimbra, “Power Electronics”, 3/e, Khanna Publishers, 1999.

Course Outcomes:
1. Name the various power electronic devices.
2. Classify the controlled rectifiers and explain the operation of each.
3. Apply Morgan, Jones and Oscillation choppers for DC motor.
4. Examine the analysis of quadrant I chopper.
5. Analyse voltage control in inverters.
6. Conclude the various applications ac-ac converters.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3		1						2		3
CO2	2	3	3	3	3		2						3		3
CO3	3	3	2	2	3		2						2		3
CO4	2	2	3	2	3		1						3		3
CO5	2	2	2	2	2		1						2		2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE3111</td><td rowspan="2">POWER SYSTEM PROTECTION</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">EECE3081: Electrical Power Generation Transmission and Distribution</td></tr>
</table>

Course Description:

This course is aimed to introduce the students the principle of protection and describes the protection of electrical power system components from faults through the disconnection of faulted parts from the rest of the electrical network. Protection scheme is to keep the power system stable by isolating only the components that are under fault. Thus, protection schemes are applicable for very pragmatic and pessimistic approach to clearing the system faults. This is a basic course for power system stability, power system operation and control and Advanced power system protection courses.

Course Educational Objectives:

- To expose basic concepts of circuit breakers and different circuit breakers.
- To impart basic idea of protective relay and different types of relays. Applications in power electronics.
- To acquaint various static relays used in protection
- To enable the various Computer-aided protection schemes
- To acquaint various static relays used in protection
- To enable the various Computer-aided protection schemes
- To enable the various Computer-aided protection schemes. electronic circuits and systems.
- To accustom different system protection schemes. power converter circuits.

UNIT 1 Circuit breakers 10 hours

Methods of arc interruption, Expression for RRRV. Resistance switching. Single frequency transients. Current chopping, interruption of capacitive currents. Classification of circuit breakers, principle of operation and constructional features of oil, air, air-blast, SF6 and vacuum circuit breakers. Ratings of circuit breakers. Testing of circuit breakers. Auto reclosing.

UNIT 2 Faults and Over-Current Protection 8 hours

Protective relays, basic idea, essential qualities of protection, Electromagnetic relays:
Types of electromagnetic relays, application, characteristics, and general equation of over current. Earth fault. Differential and distance relays. Directional relays. Protection: Feeder protection, protection of transformers, generators, motors.

UNIT 3 Static Relays 8 hours

Advantages of static relays. Comparators, amplitude, and phase comparators. Duality. Classification of static relays: over current, distance, differential protection relays.

UNIT 4 Digital Protection 8 hours

Computer-aided protection, Fourier analysis for phasor estimation, Discrete Fourier Transform and application to current and voltage phasor estimation. DFT issues like Sampling, aliasing.

UNIT 5 System Protection 8 hours

Effect of Power Swings on Distance Relaying. System Protection Schemes. Under-frequency, under-voltage and df/dt relays, Out-of-step protection, Synchro-phasors, Phasor Measurement Units and Wide-Area Measurement Systems (WAMS). Application of WAMS for improving protection systems.

List of Laboratory Experiments:

1. Study of different types of insulators.
2. Study of different types of relays.
3. Time-current characteristics of fuse.
4. Static over voltage relay.
5. Static under voltage relay.
6. Time-current characteristics of over current relay.
7. Operating characteristics of biased differential relay.
8. Earth resistance measurement.
9. Transmission line parameters.
10. Transmission line efficiency for different loads.
    a) No load with phase shift in injected voltage
    b) Mid tapped load
11. Real and reactive power flow in transmission line
12. Transmission line voltage regulation for different loads.
13. Transmission line reactive power compensation with load.
14. Enhancing the power flow of transmission line series compensation.
15. Ferranti effect of transmission line.

Textbooks:

1. Badriramand D.N. Viswakarma, “Power System Protection and Switchgear”, 2/e, Tata McGrawHill, 2011.
2. A. G. Phadke and J. S. Thorp, “Computer Relaying for Power Systems”, John Wiley & Sons, 1988.Education, 2003.

References:

1. J.B. Gupta , "Switchgear and protection", S.K.Kataria& sons,2009.
2. J. L. Blackburn, "Protective Relaying: Principles and Applications", Marcel Dekker, Newyork, 1987.1999
3. Y. G.Paithankar and S. R. Bhide, "Fundamentals of power system protection", Prentice Hall,India, 2010.
4. A. G. Phadke and J. S. Thorp, "Synchronized Phasor Measurements and their Applications", Springer, 2008.
5. D. Reimert, "Protective Relaying for Power Generation Systems", Taylor and Francis, 2006.
6. Masurements and their Applications", Springer, 2008.

Course Outcomes:

1. Explain the field of power system protection and discuss about basic operation of C.B's.
2. Demonstrate the working mechanism of circuit breakers and their selection for each of protection scheme design.
3. Compare the concept of different types of relays, including differential relay, distance relay, etc. and their selection for each protection scheme design.
4. Compare the types of static relays.
5. Develop the Digital Protection algorithms.
6. Estimate the Effect of Power Swings on Distance Relaying.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	3		1					2		2
CO2	2	3	3	3	3	2		2					3		2
CO3	2	3	3	3	3	2		2					3		2
CO4	2	3	2	2	3	2		1					2		2
CO5	3	3	3	3	3	3		1					2		2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

Programme Electives

EECE1071	BATTERY TECHNOLOGIES	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	Chemistry (Electro Chemistry)						

Course Educational Objectives:

- To understand the fundamental concepts and principles of battery technologies
- To identify the selection of appropriate battery types for specific requirements
- To develop problem-solving skills related to designing and optimizing battery systems.
- To analyse the performance and durability of various batteries
- To explore emerging trends in the context of energy storage and electric vehicles

Course Contents:

UNIT 1: Primary and Secondary Batteries **7 hours**

Definition and basic concept of primary batteries. Historical development and early types (zinc-carbon, alkaline) Electrochemical reactions in primary batteries, Anode, and cathode processes. Types of Primary Batteries, Types of Secondary Batteries, Advantages, and limitations.

UNIT 2: Lithium Based Batteries **7 hours**

Components of Lithium-ion cell and their functions, Working of Lithium-ion cell, Types of Lithium-ion cell and their comparison, Lithium-ion battery safety-mechanisms, Cathode & Anode materials.

UNIT 3: **Solid State Batteries** **8 hours**

Basic design and operation, Battery parameters and state of the art characterization techniques, Cathode and Anode materials for solid state batteries, Electrolytes for solid state batteries

UNIT 4: Battery Comparison, Manufacturing, and Packaging **9 hours**

Battery comparison related to performance, durability, and safety of these batteries in the electric vehicle applications. manufacturing aspects of cylindrical, pouch and prismatic cells, modules, and packs for electric vehicle applications.

UNIT 5: Batteries and Electric Vehicles **9 hours**

Electric Vehicle Operation, Battery Basics, Introduction to Electric Vehicle Batteries, Fuel Cell Technology, Choice of a Battery Type for Electric Vehicles. Battery sizing, Understanding of SOC, Cell balancing, BMS topologies, SoC estimation.

Textbooks:

1. Nalini, B., Abhilash, K.P., Nithyadharseni, P., 2022. Solid State Batteries-Design, Challenges and Market Demands. Springer International Publishing
2. Reddy, T.B., 2011. Linden's handbook of batteries. McGraw-Hill Education.
3. Díaz-González, F., Sumper, A. and Gomis-Bellmunt, O., 2016. Energy storage in power systems. John Wiley & Sons.
4. Scrosati, B., Abraham, K.M., van Schalkwijk, W.A. and Hassoun, J. eds., 2013. *Lithium batteries: advanced technologies and applications*. John Wiley & Sons.
5. Scrosati, B., Garche, J. and Tillmetz, W. eds., 2015. *Advances in battery technologies for electric vehicles*. Woodhead Publishing.

Course Outcomes: At the end of this course the student should be able to:

- Describe various types of battery mechanism based on electro chemical reactions (L1)
- Classify different types of batteries based on type of design and material used (L2)
- Apply mathematical formulas for designing the batteries and their parameter calculation(L3)
- Analyze performance, durability, and safety procedures for manufacturing of batteries(L4)
- Evaluate a problem description in electric vehicles and predict optimal choice of battery configuration (L5)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2		2		3	2					2	2	2	2	1
CO2	1		2		3	3					2	3	2	2	2
CO3	2		1		3	3					1	2	3	3	2
CO4	1		1		2	2					2	3	2	2	2
CO5	1		2		2	2					2	3	2	2	1

EECE3391	ELECTRICAL MACHINE DESIGN	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	EECE2081: DC Machines and Transformers, EECE3071: AC Machines						
Co-requisite	None						
Preferable exposure	MATLAB, Simulink						

Course Description:

This course is aimed to introduce the students the principles and design concepts of machines. The concepts to design the main dimensions and the operating characteristics of dc machine, transformer, induction motor and synchronous machines are highlighted. Transformers and synchronous machines designs are used during substations and power plants erection worldwide. This course is base to power electronic drives, power system stability.

Course Educational Objectives:

- To expose the students towards the major consideration in the design of electrical machines.
- To enable overall designing of transformers and learning the operating characteristics.
- To demonstrate the students the designing of induction motor stator and rotor along with performance analysis.
- To train the size and design of synchronous machines.
- To demonstrate the limitations of traditional designs and emphasizing the concepts of modern machines.

UNIT 1 General aspects 8 hours

General aspects: Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, temperature rise, rating of machines. DC Machine: Main dimensions, output equation.

UNIT 2 Transformers 6 hours

Main dimensions, KVA Output for single phase and three phase transformers, window space factor, over all dimensions, temperature rise in transformers, and method of cooling.

UNIT 3 Induction machines 8 hours

Main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, magnetizing current, short circuit current.

UNIT 4 Synchronous Machines 8 hours

Main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of turbo alternators, rotor design.

UNIT 5 Computer aided Design (CAD) 6 hours

Limitations (assumptions) of traditional designs need for CAD analysis. Introduction to FEM based machine design. Introduction to complex structures of modern machines-PMSMs, BLDCs, SRM.

Textbooks:

1. Clayton and Hancock, “Performance and Design of DC Machines”, 3/e, CBS, 2001.
2. M. G Say, “Performance and Design of AC Machines, Pitman”, 3/e, ELBS. 1983.

References:

1. A.K .Sawhney, “A course of Electrical Machine Design”, Dhanpat Rai and Sons, 1970.
2. K. M. V. Murthy, “Computer Aided Design of Electrical Machines”, B.S. Publications, 2008

Course Outcomes:

1. Understand the basic concepts of machine design parameters.
2. Identify the various factors which influence the design: electrical, magnetic and thermal loading of electrical machines.
3. Choose the design procedures to find the main dimensions of Induction Motor and learns the operating characteristic of Induction machines.
4. Designing of salient pole machine, turbo generator.
5. Understand the structures of PMSMs, BLDCs, SRM.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	3	2								3		3
CO2	2	2	3	2	3								2		2
CO3	2	3	2	3	2								2		2
CO4	2	2	3	3	3								3		3
CO5	3	3	2	3	2								3		2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE3401</td><td rowspan="2">ELECTRICAL DISTRIBUTION SYSTEMS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">EECE3081: Electrical Power Generation Transmission and Distribution</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

The structure and load patterns of a power distribution system are significantly different than transmission system. This course gives insight into various aspects of distribution system such as basic components and factors, distribution feeders, system analysis, compensation, design, operation, and coordination. In addition, distribution systems are transitioning from passive to active with the adoption of distributed generation, storage, and smart-grid technologies. Therefore, this course acts as base course for analysis of distribution systems with distributed generation.

Course Educational Objectives:

- To interpret load modelling and analyse the characteristics of loads.
- To identify the design concepts of primary and secondary systems.
- To explain substation bus schemes and know the difference between them.
- To demonstrate the coordination procedure of various protective devices.
- To determine the optimum capacitor location and can understand the applications of capacitors in distribution systems.
- To explain the importance of voltage control and list the equipment used for it.

UNIT 1 Introduction to distribution systems 8 hours

Overview of distribution systems. Load modelling and characteristics. Coincidence factor, contribution factor loss factor. Relationship between the load factor and loss factor. Classification of loads (residential, commercial, agricultural, and industrial) and their characteristics.

UNIT 2 Design considerations of distribution feeder 6 hours

Basic design practice of the secondary distribution system. Location of Substations: Rating of distribution substation, service area within primary feeders. Benefits derived through optimal location of substations.

UNIT 3 System analysis 8 hours

Voltage drop and power loss calculations: derivation for voltage drop and power loss in line, distribution automation. Energy management, load management. Limitations of distribution systems. Improvement of existing distribution system, fault locations, future orientation of rural system.

UNIT 4 Capacitive compensation for power factor control 8 hours

Different types of power capacitors, shunt and series capacitors, effect of shunt capacitors, effect of series capacitors. Power factor correction, capacitor allocation. Economic justification. Procedure to determine the best capacitor location

UNIT 5 Design, operation, and coordination 6 hours

Load variation, voltage fluctuations, Motor starting, simultaneous operation. Continuous varying loads, measure to reduce flickering. Coordination of protective devices: general coordination procedure.

Textbooks:

1. Turan Gonen, Electric Power Distribution System, Engineering, 4/e, McGraw Hill, 1985.
2. A.S. Pabla,ElectricPowerDistribution,4/e,TataMcGrawHill,1997.

References:

1. S.Sivanagaraju, V.Sankar, Electrical Power Distribution and Automation, Dhanpat Rai and Co, 2006.
2. V. Kamaraju, Electrical Power Distribution systems, 3/e, Right publishers, 2009.

Course Outcomes:

1. Demonstrate the effects of load variation, voltage fluctuations and motor starting.
2. Explain the measures to reduce flickering.
3. Interpret the need for coordination of protective devices.
4. Illustrate the general coordination procedure.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2								2		2
CO2	2	3	2	2	2								2		2
CO3	2	2	3	2	3								3		3
CO4	3	3	3	2	2								2		2
CO5	3	3	3	3	3								3		2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 ACADEMIC COUNCIL:01-04-2022

SDG No. & Statement:

SDG Justification:

EECE3411	HIGH VOLTAGE ENGINEERING	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	EECE3081: Electrical Power Generation Transmission and Distribution, EECE3091: Power System Analysis						

Course Description:

In this course it is aimed to introduce the principles of high voltage engineering to the students. Principle causes of over voltages and currents, types and protection against these over voltages and currents are discussed. Mechanism of breakdown in solids, liquids and gases, generation, measurement and testing of the high voltages and currents are enlightened in this subject.

Course Educational Objectives:

- Study the principles of power system protection
- Familiarize the phenomenon of generation of over voltages and their protection.
- Expose the mechanisms of electrical breakdown in gases, liquids and solids.
- Study the methods of generation of high voltages and currents.
- Impart the methodologies involved in measurement of high voltages and currents.
- To explain the importance of voltage control and list the equipment used for it.

UNIT 1 Over Voltages in Electrical Power Systems 8 hours

Causes of over voltages and their effects on power system, lightning, switching and temporary over voltages, Protection against over voltages, insulation coordination.

UNIT 2 Electrical breakdown in gases, solids, and liquids 6 hours

Gaseous breakdown in uniform and non-uniform fields, corona discharges. Vacuum breakdown. Conduction and breakdown in pure and commercial liquid. Breakdown mechanisms in solid and composite dielectrics.

UNIT 3 Generation of high voltage and currents 8 hours

Generation of high DC voltages, multiplier circuits. Van de Graff generator. High alternating voltage generation using cascade transformers. Production of high frequency AC high voltages. Standard impulse wave shapes. Marx circuit, generation of switching surges.

UNIT 4 Measurement of high voltages and currents 8 hours

HVDC measurement techniques. Measurement of power frequency A.C voltages. Sphere gap measurement technique, Potential divider for impulse voltage measurements. Measurement of high DC and AC impulse currents.

UNIT 5 High voltage testing 6 hours

Various standards for HV Testing of electrical apparatus. Tests on insulators. Testing of bushings, Testing of isolators and circuit breakers. Cable testing, testing of transformers. Surge diverter testing. Use of I.S for testing. Testing facility requirements, safety precautions in H. V. Labs.

Textbooks:

1. M.S Naidu., and Kamaraju, “High Voltage Engineering”, 4/e, Tata McGraw Hill, 2009.
2. E Kuffel and M.Abdullah., “High Voltage Engineering”, 2/e,Pergamon Press, 2000.

References:

1. C. L. Wadhwa., “High Voltage Engineering”, 2/e, Wiley Eastern, 2007.
2. Dieter Kind, “An Introduction to High Voltage Experimental Technique”, 1/e, Wiley Eastern, 1978.
3. Ravindra Arora, Wolfgang Mosh, “High Voltage and Electrical Insulation Engineering”, 1/e, Wiley-VCH Publishers, 2011.

Course Outcomes:

1. Define various testing standards.
2. Explain the testing of insulators, bushings, cables, and transformers.
3. Explain the testing of isolators, circuit breakers, surge diverters.
4. Outline the testing facility requirements and safety precautions.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2								2		2
CO2	3	3	2	2	3								2		3
CO3	2	2	3	3	3								2		2
CO4	3	3	3	2	2								2		2
CO5	2	3	2	3	3								3		2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 ACADEMIC COUNCIL:01-04-2022

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE3421</td><td rowspan="2">WIND AND SOLAR ENERGY SYSTEMS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">EECE3081: Electrical Power Generation Transmission and Distribution</td></tr>
</table>

Course Description:

By undergoing this course, the student will acquire the knowledge of renewable energy system particularly wind and solar PV like their historical development, control etc.

Course Educational Objectives:

- To Identify the control methods used with wind energy system.
- To Define Stall and aerodynamic control of wind turbine
- To List different solar receivers
- To Identify the Power Electronic Converters used with PV system.
- To Classify the issues while integrating PV and Wind systems to grid

UNIT 1 Overview of Wind Energy Conversion Systems 8 hours

Installed capacity and Growth rate , Small and Large wind turbines,Stand alone and grid connected Applications, On-Land and Offshore Applications, Costs of Wind Energy Conversion Systems. Fundamentals of WECS Control: Wind Turbine Components. Wind Turbine Aerodynamics: Power Characteristic of Wind Turbines, Aerodynamic Power Control: Passive Stall, Active Stall, and Pitch Control, Tip Speed Ratio. Maximum Power Point Tracking Control: MPPT with Turbine Power Profile, with Optimal Tip Speed Ratio and with Optimal Torque Control.

UNIT 2 Wind Turbine Technology 9 hours

Horizontal- and Vertical-Axis Wind Turbines, Fixed-and Variable-Speed Turbines, Stall and Pitch Aerodynamic Power Controls. Fixed-Speed WECS without Power Converter Interface, Variable-Speed Systems with Reduced-Capacity Converters, Variable-Speed Systems with Full-Capacity Power Converters. on.

UNIT 3 The Solar Resource 8 hours

Introduction, solar radiation spectra, solar geometry, Energy sun angles, Observer sun angles, solar day length, Estimation of solar energy availability.

UNIT 4 Solar photovoltaic 10 hours

Technologies-Amorphous, mono crystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT)algorithm.

UNIT 5 Network Integration Issues 10 hours

Overview of grid code technical requirements, fault ride-through for wind farms -real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.

Textbooks:

1. Bin_Wu,_Yongqiang_Lang,_Navid_Zargari,_Samir_Kour,"Power Conversion and Control of Wind Energy Systems", IEEE Press Series on Power Engineering, John Wiley and SonsLtd.,2011.
2. S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill, 1984.

References:

1. G. M. Masters, "Renewable and Efficient Electric Power Systems", John Wiley and Sons, 2004."
2. T. Ackermann, "Wind Power in Power Systems", John Wiley and Sons Ltd.,2005
3. H. Siegfried and R. Waddington, "Grid integration of wind energy conversion systems" John Wiley and Sons Ltd.,2006.
4. G. N. Tiwari and M. K. Ghosal, "Renewable Energy Applications", Narosa Publications,2004.

Course Outcomes:

1. Understand the history and operating principles of PV and Wind energy conversion
2. Evaluate the control methods used in PV and Wind energy systems
3. Understand Solar geometry and solar collectors
4. Identify the Power Electronic Converter and maximum power point tracking method
5. List the different grid integrating issues like power quality etc

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2		2	2		3	2	3	2	2	2			
CO2	2	2		2				2	2		2	3	2		
CO3	2	2						2	2		2	3	2		
CO4	2	2	2				2		2		2	3	2		
CO5	3	2	2	3	2		2	2	2		2	3	2		

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE4101</td><td rowspan="2">ARTIFICIAL INTELLIGENCE APPLICATIONS TO POWER SYSTEMS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course is aimed to introduce the concepts of rule based expert system, Artificial neural networks, Genetic Algorithm and Hybrid intelligence techniques. This course deals with applications of rule based expert system, Artificial neural networks, Genetic to power systems with the help of simulation studies.AI with the help of sophisticated computer tools is applied to resolve stability, strengthening, reliability, technical advancements, problems for large power systems.

Course Educational Objectives:

- Motivation to design fuzzy systems and control.
- The study of control-theoretic foundations such as stability and robustness in the framework of fuzzy control.
- Analysis of learning systems in conjunction with feedback control systems.
- Exposure to many real-world fuzzy control problems.

UNIT 1 Expert systems 8 hours

Characteristics of fuzzy logic systems, fuzzy logic in power systems.

UNIT 2 Fuzzy Logic 9 hours

Characteristics of fuzzy logic systems, fuzzy logic in power systems.

UNIT 3 Artificial neural networks 8 hours

Artificial neural networks, neural network types, neural networks in power systems.

UNIT 4 Genetic algorithm 10 hours

Characteristics of genetic algorithm, genetic algorithms in power systems.

UNIT 5 Hybrid systems 10 hours

Hybrid intelligence techniques, application in power systems.

Textbooks:

1. D.W.Patterson, ”Introduction to Artificial Intelligence and Expert systems”, 2/e , PHI, 2009.

References:

1. Yong-Hua Song, Allan Johns, Raj Aggarwal, “Computational Intelligence Applications to Power Systems”, Science Press, 1/e, Kluwer Academic Publishers,1997.

Course Outcomes:

1. Provide a strong understanding of Fuzzy Systems theory and design principles (L3).
2. Provide a good understanding of fuzzy logic controller design (L3).
3. Provide a good understanding of fuzzy PID controller design (L3).
4. Provide a good understanding of fuzzy logic based optimization (L3).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2		2	2		3	2	3	2	2	2			
CO2	2	2		2				2	2		2	3	2		
CO3	2	2						2	2		2	3	2		
CO4	2	2	2				2		2		2	3	2		
CO5	3	2	2	3	2		2	2	2		2	3	2		

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

EECE3431	ELECTRIC DRIVES	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	EECE3101: Power Electronics						
Co-requisite	None						
Preferable exposure	None						

Course Description:

In this course it is aimed to enable the students on introduction to the operation of electric drives controlled from a power electronic converters and also provides the design concepts of controller. To familiarize students with applications of electric motor drives in industries. This can be a base course for Advanced AC and DC Electrical drives.

Course Educational Objectives:

- To introduce main principles of drives
- To familiarize with basic requirements placed by mechanical systems on electric drives.
- To study the basic concept of electric braking.
- To enable with phase controlled DC motor drives.
- To expose to power electronic controlled AC drives.

UNIT 1 Introduction 8 hours

Electric Drives and its parts, advantages of electric drives, Classification of electric drives, multi-quadrant operations, Constant torque and constant power operation, Types of load torque: components, nature and classification.

UNIT 2 Dynamics of Electric Drives 9 hours

Dynamics of motor-load combination Steady state stability of Electric Drive, Transient stability of electric Drive, Selection of Motor Power rating: Thermal model of motor for heating and cooling, classes of motor duty, determination of motor power rating for continuous duty, short time duty and intermittent duty; Load equalization .

UNIT 3 Electric Braking 8 hours

Purpose and types of electric braking, braking of DC, three phase induction and synchronous motors, Calculation of acceleration time and energy loss during starting of DC shunt and three phase induction motors, Energy relations during braking

UNIT 4 Power Electronic Control of DC Drives 10 hours

1- phase and 3- phase controlled converter fed separately excited DC motor drives (continuous conduction only), dual converter fed separately excited DC motor drive, rectifier control of DC series motor, Chopper control of separately excited DC motor and DC series motor.

UNIT 5 Connecting to the Cloud 10 hours

3-Phase induction Motor Drive- Static Voltage control scheme, static frequency control scheme (VSI, CSI, and cyclo – converter based), static rotor resistance and slip power recovery control schemes. 3-Phase Synchronous motor-staring using SCR's, Self controlled and true synchronous scheme.

Textbooks:

1. G.K. Dubey, "Fundamentals of Electric Drives", Narosa publishing House.
2. S.K. Pillai, "A First Course on Electric Drives", New Age International.
3. B.N. Sarkar, "Fundamental of Industrial Drives", Prentice Hall of India Ltd.

References:

1. M. Chilkin, "Electric Drives",Mir Publishers, Moscow.
2. Mohammed A. El-Sharkawi, "Fundamentals of Electric Drives", Thomson Asia, Pvt. Ltd. Singapore.
3. N.K. De and Prashant K. Sen, "Electric Drives", Prentice Hall of India Ltd.

Course Outcomes:

1. What is electric drives (L1)
2. Identify the different types of load torques (L3)
3. Illustrate the operation of electric drive (L2) excitation (L3).
4. Define the dynamics in the motor -load combinations. (L1)
5. Identify the suitable motor for suitable applications. (L3)
6. Develop a suitable braking system to a suitable electric drive (L3)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1		2			1					2			
CO2	3	1		2			1					2			
CO3	3	1		2			1		1			2			
CO4	3	3		2			1		2			2			
CO5	3	3		4			2		1	1	1	2			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 ACADEMIC COUNCIL:01-04-2022

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE3441</td><td rowspan="2">INDUSTRIAL ELECTRICAL SYSTEMS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">EECE3081: Electrical Power Generation Transmission and Distribution</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course is designed around industrial maintenance personnel, to help them diagnose and repair electrical faults. The significance of this course is to equip learners with the skills and knowledge necessary to successfully carryout basic service and maintenance. This course is basic for utilization of electrical energy.

Course Educational Objectives:

- To introduce students to LT system wiring components
- To train students about residential and commercial wiring systems
- To import students about various illumination systems
- To acquaint students about various substation equipment and DG systems
- To demonstrate the students role industrial electrical system automation using PLC’s and SCADA

UNIT 1 Electrical system components 8 hours

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices

UNIT 2 Residential and Commercial Electrical Systems 9 hours

Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

UNIT 3 Illumination Systems 8 hours

Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premise, flood lighting.

UNIT 4 Industrial Electrical Systems 10 hours

Industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels, Specifications of LT Breakers, MCB and other LT panel components. DG Systems,
UPS System, Selection of UPS and Battery Banks.

UNIT 5 Industrial Electrical System Automation 10 hours

Study of basic PLC, Role of PLC in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.

Text Books:

1. S. L. Uppal and G. C. Garg, "Electrical Wiring, Estimating &Costing", Khanna publishers, 2008
2. H. Joshi, "Residential Commercial and Industrial Systems", McGraw Hill Education, 2008

References:

1. K. B. Raina, "Electrical Design, Estimating & Costing", New age International, 2007
2. S. Singh and R. D. Singh, "Electrical estimating and costing", DhanpatRai and Co., 1997. Web site for IS Standards

Course Outcomes:

1. Student will be able to explain the importance of protection components
2. Student will be able to demonstrate residential and commercial wiring system
3. Student will be able to estimate lighting schemes for residential and commercial premises
4. Student will be able to distinguish different types of compensation devices
5. Student will be able to determine the role of automation

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1		2			1					2			
CO2	3	1		2			1					2			
CO3	3	1		2			1		1			2			
CO4	3	3		2			1		2			2			
CO5	3	3		4			2		1	1	1	2			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE3451</td><td rowspan="2">POWER QUALITY AND FACTS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">EECE3091: Power System Analysis, EECE3101: Power Electronics</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course is aimed to introduce the students working principles of various FACTS devices and power quality issues in practical power systems. The basic concepts of reactive power compensation and power quality conditions are explained. Different configurations and control strategies of various FACTS devices are analysed. FACTS are used to increase transmission capacity, voltage control, and power flow control.

Course Educational Objectives:

The purpose of the course is to

- Expose basic concepts of reactive power compensation.
- Study various series and shunt compensating FACTS
- Analyse the working of VSC, STATCOM, SSSC and UPFC
- Expose the various power quality problems.
- Interpret the working of DSTATCOM, DVR and UPQC

UNIT 1 Transmission Lines and Series/Shunt Reactive Power Compensation 8 hours

Basics of AC Transmission. Analysis of uncompensated AC transmission lines. Reactive Power Compensation. Shunt and series compensation at the mid-point of an AC line. Comparison of Series and Shunt Compensation.

UNIT 2 Thyristor-based Flexible AC Transmission Controllers (FACTS) 8 hours

Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Thyristor Controlled Braking Resistor and Single Pole Single Throw (SPST) Switch. Configurations/Modes of Operation, Harmonics and control of SVC and TCSC. Fault Current Limiter.

UNIT 3 Voltage Source Converter based (FACTS) Controllers 10 hours

Voltage Source Converters (VSC): Six Pulse VSC, Multi-pulse and Multi-level Converters, Pulse-Width Modulation for VSCs. Selective Harmonic Elimination, Sinusoidal PWM and Space Vector Modulation. STATCOM: Principle of Operation, Reactive Power Control: Type I and Type II controllers, Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC): Principle of Operation and Control.

UNIT 4 Power Quality Problems in Distribution Systems 8 hours

Introduction of the Power Quality (PQ) problem, Terms used in PQ: Voltage, Sag, Swell, Surges, Harmonics, over voltages, spikes, Voltage fluctuations, Transients, Interruption, overview of power quality phenomenon, Sources of PQ problems, Remedies to improve PQ, power quality monitoring.

UNIT 5 DSTATCOM, DVR, UPQC 8 hours

Reactive Power Compensation, Harmonics and Unbalance mitigation in Distribution Systems using DSTATCOM and Shunt Active Filters. Synchronous Reference Frame Extraction of Reference Currents. Current Control Techniques in for DSTATCOM. Voltage Sag/Swell mitigation: Dynamic Voltage Restorer – Working Principle and Control Strategies. Series Active Filtering. Unified Power Quality Conditioner (UPQC): Working Principle Capabilities and Control Strategies.

Textbooks:

1. N. G. Hingorani and L. Gyugyi, “Understanding FACTS: Concepts and Technology of FACTS Systems”, Wiley-IEEE Press, 1999.
2. K. R. Padiyar, “FACTS Controllers in Power Transmission and Distribution”, New Age International (P) Ltd. 2007.
3. T. J. E. Miller, “Reactive Power Control in Electric Systems”, John Wiley and Sons, New York, 1983.

References:

1. R. C. Dugan, “Electrical Power Systems Quality”, McGraw Hill Education, 2012.
2. G. T. Heydt, “Electric Power Quality”, Stars in a Circle Publications, 1991

Course Outcomes:

Upon completion of the course, the students would be able to

- Compare various reactive power compensation techniques. (L2)
- Identify various series and shunt compensating devices in FACTS (L3)
- Estimate the location of VSC, STATCOM, SSSC and UPFC (L6)
- Evaluate various power quality problems. (L4)
- Appraise the working of DSTATCOM, DVR and UPQC (L5)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1		2			1					2			
CO2	3	1		2			1					2			
CO3	3	1		2			1		1			2			
CO4	3	3		2			1		2			2			
CO5	3	3		4			2		1	1	1	2			

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

EECE3461	HVDC TRANSMISSION SYSTEMS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	EECE3081: Electrical Power Generation Transmission and Distribution, EECE3091: Power System Analysis, EECE3101: Power Electronics						
Co-requisite	None						
Preferable exposure	None						

Course Description:

In this course it is aimed to introduce to the students the principles, operation, and control of HVDC transmission systems. The historical aspects of HVDC systems, types of HVDC, Converter configurations, control of converters, faults in HVDC, harmonics and elimination of harmonics are discussed in this subject.

Course Educational Objectives:

The purpose of the course is to

- Study operational concerns of existing HVDC
- Demonstrate Next generation HVDC Technologies
- Expose HVDC Converter operation & control.
- Train with the protection of HVDC system.
- Study of Harmonic generation and Filtering.

UNIT 1 General aspects and converter circuits 10 hours

Historical developments, HVAC and HVDC links comparison, Economic technical performance, reliability, limitation. Modern Trends in HVDC Technology, Application of DC Transmission, Properties of thyristor converter circuits, assumptions, choice of best circuit for HVDC converters, Components of a HVDC system.

UNIT 2 Bridge converters analysis 8 hours

Assumptions, Analysis with gate control bus no overlap, Analysis with gate control and overlap less than 60 degrees. Expressions for average dc voltage, AC current and reactive power absorbed by the converters. Equivalent circuit for rectifier, Operation of inverter, Equivalent and modified equivalent circuit of HVDC link.

UNIT 3 Bridge converters control 8 hours

Basic means of control, power reversal, desired features of control, actual control characteristics, Basic characteristics, modification of control characteristics, System control hierarchy, firing angle control schemes

UNIT 4 Mis-operation of Converters and Protection 8 hours

Converter disturbance, bypass action in bridges, Commutation failure, basics of protection, DC reactors, DC circuit breakers, over voltage protection.

UNIT 5 Harmonics and Multi Terminal DC (MTDC) systems 8 hours

Characteristic and uncharacteristic harmonics, Troubles due to harmonics, harmonic filters, single tuned and double tuned filters, Multi-Terminal Systems: Series and Parallel MTDC systems operation.

Textbooks:

1. E.W. Kimbark, "HVDC Transmission" , John Wiley publishers.
2. K.R.Padiyar , "HVDC Transmission", 3/e, New age Publishers, 2013.

References:

1. A. Chakraborthy, M.L.Soni, P.V.Gupta,"A Text Book on Power System Engineering", 1/e, Dhanpatrai and Sons, 2008.

Course Outcomes:

Upon successful completion of the course the students will be able to

- Explain the historical developments, advantages and drawbacks, applications, types and economic factors of a.c. and d.c transmission systems.
- Analyze various converter configurations.
- Develop equivalent circuit of HVDC system.
- Conclude various faults and protection schemes employed in HVDC.
- Develop the circuits for elimination of harmonics in HVDC systems.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	2	3								3		3
CO2	2	2	3	3	3								3		2
CO3	2	3	3	2	3								2		3
CO4	2	2	3	2	3								2		2
CO5	2	3	3	2	3								2		3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 ACADEMIC COUNCIL:01-04-2022

SDG No. & Statement:

SDG Justification:

EECE4111	HYBRID ELECTRIC VEHICLES	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course introduces the fundamental concepts, principles, analysis and design of hybrid and electric vehicles. The course will be useful for post-graduate students, teachers, practitioners and final year undergraduate students. This course goes deeper into the various aspects of hybrid and electric drive train such as their configuration, types of electric machines that can be used, energy storage devices, etc. Each topic will be developed in logical progression with up-to-date information.

Course Educational Objectives:

The purpose of the course is to

- Study various basic concepts of hybrid and electric vehicles.
- Expose various basic conventional vehicle performance and various hybrid drive-train topologies.
- Familiarize various electric components used in hybrid and electric vehicles
- Expose various energy storage requirements in hybrid and electric Vehicles
- Interpret the energy management strategies used in hybrid and electric vehicles.

UNIT 1 Basic concepts of Hybrid Electric Vehicles 8 hours

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

UNIT 2 Conventional Vehicles 10 hours

Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance.
Hybrid Electric Drive-Trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

UNIT 3 Electric Propulsion Unit 8 hours

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

UNIT 4 Energy Storage 8 hours

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

UNIT 5 Energy Management Strategies 8 hours

Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

Text Books:

1. Chrismi, M. AbulMasrur and David WenzhangGao, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, Wiley, 2011.
2. Yang Sheng Xu, HuihuanQian, Jingyu Yan and Tin Cun Lam, Hybrid Electric Vehicle Design and Control: Intelligent Omnidirectional Hybrids, IET, 2014.

References:

1. Iqbal Hussein, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press, 2003.
2. MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design”, CRC Press, 2004..

Course Outcomes:

Upon completion of the course, the students would be able to

1. Compare the difference between hybrid and electric vehicles (L2)
2. Identify different hybrid drive-train topologies. (L3)
3. Estimate the various electric components used in hybrid and electric vehicles (L5)
4. Assess various problems in hybridization of different energy storage devices. (L5)
5. Predict various issues of energy management strategies. (L6)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	2	2		3	2					3		2
CO2	2	3	2	2	2		3	2					3		3
CO3	3	3	2	3	3		2	2					2		2
CO4	3	2	2	3	2		2	2					2		2
CO5	3	2	3	2	2		2	2					2		3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

EECE3471	PROCESS CONTROL AND AUTOMATION	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	EECE2091: Linear Control Systems, EECE3061: Electrical Measurements						

Course Description:

Proper application of process control improves the safety and profitability of a process, while maintaining consistently the desired product quality. The automation of selected functions have relieved plant personnel of tedious, routine tasks, providing them with time and data to monitor and supervise operations in real-time. This course aims to provide in-depth understanding of designing and implementing practical control strategies in process industries.

Course Educational Objectives:

The purpose of the course is to

- Familiarize the basic principles & importance of process control in industrial process plants.
- Study the required instrumentation and final elements to ensure that well-tuned control is achieved.
- Train the use of block diagrams & the mathematical basis for the design of control systems.
- Create and tune process (PID) controllers.
- Impart software tools for the modeling of plant dynamics and the design of well-tuned control loops.
- Expose the importance and application of good instrumentation for the efficient design of process control loops for process engineering plants.
- Demonstrate the experimental implementation of advanced process control schemes and the methods for process monitoring and diagnosis.

UNIT 1 Fundamentals of process control 10 hours

Definition of industrial processes and control. Hierarchies in process control systems block diagram representation of process control system. Control system instrumentation, codes and standards, preparation of P& I diagrams.

UNIT 2 Strategies for computer aided process control 8 hours

Open loop control systems, closed loop (feed back) control system, feed forward control system, cascade control system, ratio control. Controller design, controller tuning, tuning of P, PI and PID controllers, Ziegler Nichols tuning method, selection of controllers, predictive control, model based predictive control, multivariable control system.

UNIT 3 Programmable logic controllers (PLCs) 8 hours

Introduction, principles of operation, architecture of programmable logic controllers. Programming the programmable controllers, software, configurations, applications.

UNIT 4 Distributed control systems 8 hours

Introduction, functional requirements of distributed control system, system architecture, distributed control systems configuration and applications of distributed control systems.

UNIT 5 Industrial control applications 8 hours

Automation of thermal power plant, automation strategy, distributed system structure, automatic boiler controller, diagnostic function and protection, digital electro, hydraulic governor, automatic startup system, thermal stress control, man, machine interface, software system, communication system, variable pressure control, combined plant control.

Textbooks:

1. Krishna Kant, "Computer based Industrial Control", 2/e, Prentice, Hall India, 2010.
2. S.K.Singh, "Computer Aided Process Control", 3/e, Prentice,Hall India, 2005.

References:

1. D.E Seborg, T.F. Edgar, and D.A. Mellichamp . "Process Dynamics and Control" 3/e, John Wiley, 2010.
2. Johnson D Curtis, "Instrumentation Technology", 8/e, Prentice,Hall India, 2008.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2								2		2
CO2	3	2	1	3	3								2		2
CO3	3	3	2	2	3								2		2
CO4	2	3	2	3	2								3		2
CO5	3	2	2	2	3								2		2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 ACADEMIC COUNCIL:01-04-2022

SDG No. & Statement:

SDG Justification:

EECE3481	DIGITAL CONTROL SYSTEMS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	EECE2091: Linear Control Systems						

Course Description:

Digital control is a branch of control theory that makes use of digital systems for acting as controllers in a system. Digital Control systems are an integral part of everyday life in today's society. They control appliances, entertainment centers, office environments, industrial processes and our transportation systems. Almost all of these applications use digital controllers implemented with computers, microprocessors, or digital electronics. Every electrical engineering student should therefore be familiar with the basic theory of digital controllers as it lays the foundation for advanced control systems.

Course Educational Objectives:

The purpose of the course is to

- Expose digital representation of continuous systems
- Analyze a discrete time system with mathematical tools like Z transforms
- Analyze stability of discrete time system
- Interpret state variable analysis
- Design a digital control system

UNIT 1 Discrete Representation of Continuous Systems 8 hours

Basics of Digital Control Systems. Discrete representation of continuous systems. Sample and hold circuit. Mathematical Modelling of sample and hold circuit. Effects of Sampling and Quantization. Choice of sampling frequency. ZOH equivalent.

UNIT 2 Discrete System Analysis 10 hours

Z-Transform and Inverse Z Transform for analyzing discrete time systems. Pulse Transfer function. Pulse transfer function of closed loop systems. Mapping from s-plane to z plane. Solution of Discrete time systems. Time response of discrete time system.

UNIT 3 Stability of Discrete Time System 8 hours

Stability analysis by Jury test. Stability analysis using bilinear transformation. Design of digital control system with dead beat response. Practical issues with dead beat response design

UNIT 4 State Space Approach for discrete time systems 10 hours

State space models of discrete systems, State space analysis. Lyapunov Stability. Controllability, reach-ability, Re-constructability and observability analysis. Effect of pole zero cancellation on the controllability & observability.

UNIT 5 Design of Digital Control System 10 hours

Design of Discrete PID Controller, Design of discrete state feedback controller. Design of set point tracker. Design of Discrete Observer for LTI System. Design of Discrete compensator. Design of discrete output feedback control.

Text Books:

1. K. Ogata, “Digital Control Engineering”, Prentice Hall, Englewood Cliffs, 1995.
2. M.Gopal, “Control Systems Engineering” , 3/e , Wiley Eastern Ltd., TMH ,2008

References:

1. G. F. Franklin, J. D. Powell and M. L. Workman, “Digital Control of Dynamic Systems”, Addison-Wesley,1998.
2. B.C. Kuo, “Digital Control System”, Holt, Rinehart and Winston, 1980.

Course Outcomes:

Upon successful completion of the course the students will be able to

1. Represent continuous systems in discrete domain. (L2)
2. Analyze a discrete time system using Z transforms . (L3)
3. Determine the time response of discrete time system. (L4)
4. Evaluate the stability of discrete system . (L5)
5. Construct state space models of discrete systems and performing their stability analysis (L5)
6. Design a digital control system for different applications(L6)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	2	2								2		2
CO2	3	2	2	2	3								2		3
CO3	3	2	1	3	2								3		3
CO4	3	3	2	2	2								2		2
CO5	2	3	2	3	2								2		2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE4121</td><td rowspan="2">ADVANCED CONTROL SYSTEMS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">EECE2091: Linear Control Systems</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Educational Objectives:

The purpose State space analysis is

- To conceptualize state variable systems.
- To enlist common types of non linear characteristics, linearization.
- To exemplify basic concepts describing function.
- To familiarize pole placement technique by state feedback for linear siso time invariant system.
- To theorize optimal control, adaptive control, robust control and intelligent control methods. Introduction to distributed control systems.

UNIT 1 State space analysis .State variable systems. 10 hours

State space analysis .State variable systems. Controllability and observability .State variable feedback and its effect on controllability and observability. Elements of observer theory

UNIT 2 Common types of non linear characteristics, linearization 8 hours

Common types of non linear characteristics, linearization. Singular points. Phase plane methods, construction of phase trajectories. Isocline Method. Pell's method. Delta method. Stability analysis using phase trajectories.

UNIT 3 Basic concepts of describing function 8 hours

Basic concepts of describing function, derivation of describing functions of Common types of non linear characteristics. Stability of non linear systems by describing function method, Lyapunov's method of stability studies , Popov's criterion.

UNIT 4 Pole placement technique by state feedback for linear SISO time invariant system 8 hours

Pole placement technique by state feedback for linear SISO time invariant system. Design of state observations and servo system.

UNIT 5 Optimal control 8 hours

Optimal control, adaptive control, robust control and intelligent control methods. Introduction to distributed control systems.

Text Books:

1. Nagarath and Gopal, "Control System Engineering", 2/e, Wiley Eastern, 2001.
2. Stanley M.Shiners, "Modern Control System theory and Design", 2/e, John Wiley and Sons, Singapore, 1992.

References:

1. Ogata. K, "Modern Control Engineering" ,4/e, PHI,2002.

Course Outcomes:

Students will be able

1. To understand state variable systems.
2. To infer common types of non linear characteristics, linearization.
3. To learn basic concepts describing function.
4. To comprehend pole placement technique by state feedback for linear siso time invariant system.
5. To apply optimal control, adaptive control, robust control and intelligent control methods. introduction to distributed control systems.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	2	3								2		2
CO2	2	2	1	3	2								3		2
CO3	3	3	1	2	3								3		3
CO4	2	2	2	3	3								3		3
CO5	3	2	2	2	2								3		3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE3491</td><td rowspan="2">MODERN CONTROL SYSTEMS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">EECE2091: Linear Control Systems</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

The role of control systems in engineering will continue to expand as the global issues facing us require ever increasing levels of automation and precision. Control engineering is an exciting and a challenging field. By its very nature, control engineering is a multidisciplinary subject. The ultimate significance is to implement controllers in real feedback control systems. Development of control engineering methodology is based on mathematical fundamentals, stresses physical system modeling and practical control system designs with realistic system specifications. This can be base course for Advance control systems.

Course Educational Objectives:

- Discuss of various controllers for closed loop feedback system to obtain desired performance.
- Develop the compensators for the open-loop plant so that it can safely be used with feedback control in frequency domain.
- Demonstrate stability of the system using state space analysis.
- Design of state feedback controllers and compensators based on pole placement technique.
- Illustrate and Analyze the physical systems in discrete time using mathematical tools like z-transform method.

UNIT 1 Controllers. 10 hours

Introduction to Block diagram of on-off control, proportional control, integral control, derivative control, PI, PD and PID control. Control objective, feedback control systems characteristics, proportional mode of feedback control, integral mode of feedback control, derivative mode of feedback control.

UNIT 2 Cascade Compensation 8 hours

Cascade lead compensation, cascade lag compensation, cascade laglead compensation. Cascade lead compensation using Root locus. Cascade lag compensation using Root locus. Cascade Lag-Lead Compensation using Root locus. Reshaping the Bode plot, cascade lead compensation using Bode Plot. Cascade lag compensation using Bode Plot. Cascade Lag-Lead Compensation using Bode Plot.

UNIT 3 State Space Analysis of Continuous time Control Systems: 8 hours

State diagram, state transition matrix, conversion of state variable models to transfer function. Conversion of transfer functions to canonical state variable models. Solution of state variable models, state transmission matrix, solution of state equations.

UNIT 4 Design of state feedback controller 8 hours

Introduction, controller design by pole placement, definition of observability and controllability.

UNIT 5 Discrete time systems: 8 hours

Introduction to discrete time systems, analog and digital controllers, the z transformation, basic definition of z-transform, derivation of z -transform of standard functions. Difference equation and its solution by the z-transform method. Initial value and Final value theorems. Inverse z-transform by expanding X(z) into (i) an infinite power series and (ii) partial fractions. Pulse transfer functions, pulse transfer function of closed loop system using signal flow graph technique. Stability analysis in z-plane.

Textbooks:

1. M.Gopal,ControlSystems:PrinciplesandDesign,2/e,McGrawHill,2002.

References:

1. Katsuhiko Ogata, Modern Control Engineering, 5/e, Prentice Hall of India, 2010.
2. M. Gopal, Digital Control and State Variable Methods, 4/e, McGrawHill, 2012.

Course Outcomes:

Upon successful completion of the course the students will be able to

1. DesignP,PI,PID controllers for closed loop system.
2. Develop compensators in frequency domain for closed loop system.
3. Evaluate the system stability using state space analysis.
4. Develop the pole placement technique for controllers and compensators.
5. Analyzea discrete time system using z-transform.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	3	3								2		2
CO2	2	2	2	2	3								2		2
CO3	3	3	1	2	3								3		2
CO4	2	2	2	2	2								2		3
CO5	2	2	1	3	3								2		2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

EECE4131	NONLINEAR CONTROL SYSTEMS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	EECE2091: Linear Control Systems						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course is aimed to introduce concepts of Non-linear systems, and characteristics of Nonlinear systems. Equilibrium points in the non-linear systems, and their classification are studied. Different methods for analysis of nonlinear systems are studied. Stability assessment methods for nonlinear systems are investigated.

Course Educational Objectives:

- To introduce the need and concept of nonlinear system.
- To impart knowledge about different strategies adopted in the analysis of nonlinear systems.
- To familiarize with the design of different types of nonlinear controllers.

UNIT 1 Introduction 10 hours

Characteristics of nonlinear systems –Phase plane method- Classification of equilibrium points- analysis of systems with piecewise constant inputs using phase plane analysis. Describing function Method.

UNIT 2 Stability of Nonlinear Systems 10 hours

Stability of Nonlinear Systems - Lyapunov stability - local stability - local linearization and stability in the small- Direct method of Lyapunov - generation of Lyapunov function for linear and nonlinear systems – variable gradient method.

UNIT 3 Centre manifold theorem 8 hours

Centre manifold theorem - region of attraction - Feedback Control and Feedback Stabilization Analysis of feedback systems- Circle Criterion – Popov Criterion.

UNIT 4 Feedback linearization 7 hours

Feedback linearization- Design via linearization- stabilization - regulation via integral control-gain scheduling

UNIT 5 Exact Feedback Linearization 7 hours

Exact Feedback Linearization - Input state linearization - input output linearization - state feedback control - stabilization - tracking - integral control

Textbooks:

1. Hassan K Khalil, Nonlinear Systems, Prentice - Hall International (UK), 2002.
2. Jean-Jacques E. Slotine and Weiping Li, “Applied Nonlinear Control”, Prentice-Hall, NJ, 1991.

References:

1. M Vidyasagar, ”Nonlinear systems Analysis”, 2nd Edition, Prentice Hall, 1993.
2. Alberto Isidori, ”Nonlinear Control System”, Vol I and II, Springer, 1999

Course Outcomes:

Upon successful completion of the course the students will be able to

1. Construct the phase plane trajectory of a given nonlinear system (L3)
2. Explain describing function for various nonlinearities (L2)
3. Identify the stability of the given linear and nonlinear system using Lyapunov stability theory (L4)
4. Analyze the stability of the nonlinear system(L4).
5. Design systems using concept of tracking (L3).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	1	2	2								2		3
CO2	2	2	1	3	3								3		2
CO3	3	2	1	3	3								3		3
CO4	3	2	1	3	2								3		3
CO5	3	3	2	2	2								3		3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 ACADEMIC COUNCIL:01-04-2022

SDG No. & Statement:

SDG Justification:

EECE3501	ROBOTICS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

Robotics and automation is a branch of Engineering that involves the design, manufacturing, and operation of robots. It overlaps many fields of Engineering including Electronics, Computer Science, Artificial Intelligence, Automation and Nanotechnology. This course has its applications in industries related to Aerospace, Defense contractors, Entertainment, Manufacturing, Medical research (development of prosthetic parts).

Course Educational Objectives:

- To be familiar with history of robotics, technological advances and to gain insight on different types of End Effectors.
- To learn about different robotic drive systems, actuators and their control.
- To analyze the robotic Kinematics in different degrees of freedom4.To study the principles of various Sensors used in robotics
- To explore industrial applications of Robotics.

UNIT 1 — Introduction — 9 hours

Historical robots, robots in science fiction, future trends of robots, definitions of robots, present application status. Robot End Effectors: Classification of end effectors, drive systems for grippers, mechanical grippers, magnetic grippers, vacuum grippers, adhesive grippers, hooks, scoops and other miscellaneous devices, active and passive grippers.

UNIT 2 — Robot Drives, Actuators and Control — 9 hours

Functions of drive systems, general types of control, pump classification, introduction to pneumatic systems, electrical drives, dc motors and transfer functions, stepper motor, drive mechanisms.

UNIT 3 — Robot Kinematics — 7 hours

Forward and reverse kinematics of 3 degrees of freedom robot arm, forward and reverse kinematics of a 4 degree of freedom, arm manipulator in 3-D, homogeneous transformations

UNIT 4 — Robot Sensors — 9 hours

Need for sensors, types of sensors, robot vision systems, robot tactile systems, robot proximity sensors, robot speech and hearing, speech synthesis, noise command systems, speech recognition systems

UNIT 5 Robot Intelligence & Programming the Robots 9 hours

Robot Intelligence & Programming the Robots: AI and Robotics, Expert Systems, Interpreting Sensory Inputs, Intelligent Tutoring Systems. Robot Languages, Robot Operating System, Robot Application Programming, Teaching Robots

Textbooks:

1. S.R. Deb, Robotics Technology and Flexible Automation, TMH, 2010.

References:

1. SatyaRanjan, Robotics Technology and Flexible Automation, TMH, 2001.
2. James L.Fuller, Robotics: Introduction, Programming and Projects, Maxwell Macmillan, 2000

Course Outcomes:

1. Get acquainted with history of robotics, technological advances and many types of End Effectors (L2).
2. Gain knowledge on different robotic drive systems, actuators and their control (L2).
3. Understand the robotic Kinematics (Robotic movements, Position and Orientation) (L2).
4. Select the Sensors based on different applications (L4).
5. Understand industrial applications of Robotics (L2)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	3	2					2		2	2
CO2	3	3	3	2	3	2	1					2		2	2
CO3	3	3	2	2	2	3	1					3		2	3
CO4	2	3	3	2	3	3	2					3		2	3
CO5	2	3	2	2	2	2	2					3		3	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 ACADEMIC COUNCIL:01-04-2022

SDG No. & Statement:

SDG Justification:

EECE3511	ROBOT KINEMATICS AND DYNAMICS	L	T	P	S	J	C
		2	0	2	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	Engineering Mechanics						

Course Description:

This course teaches the fundamentals of robotics required to design the robot anatomy, kinematics of robots, robot dynamics, robot drive systems, robot programming and its applications. The Knowledge gained from this course is to apply the concepts in handling the automated systems like assembly systems, material handling systems, storage, and retrieval systems.

Course Educational Objectives:

- To familiarize the concepts of forward kinematics.
- To familiarize the concepts of robot manipulator kinematics
- To explain the concepts related to inverse kinematics
- To illustrate the working of actuators robotic links and joints
- To develop the ability to understand trajectory generation

UNIT 1 Forward Kinematics, Product of Exponentials Formula, First Formulation 8 hours

Forward Kinematics, Product of Exponentials Formula, First Formulation: Screw Axes in the Base Frame, examples, Second Formulation: Screw Axes in the End-Effector Frame, examples

UNIT 2 Velocity Kinematics and Statics 6 hours

Velocity Kinematics and Statics, Manipulator Jacobian, Space Jacobian, Body Jacobian, Visualizing the Space and Body Jacobian, Relationship between the Space and Body Jacobian

UNIT 3 Introduction to Inverse Kinematics 8 hours

Introduction to Inverse Kinematics, Numerical Inverse Kinematics: Newton–Raphson Method, Inverse Velocity Kinematics

UNIT 4 Actuation, Gearing, and Friction 8 hours

Actuation, Gearing, and Friction: DC Motors and Gearing, Apparent Inertia, Newton–Euler Inverse Dynamics Algorithm Accounting for Motor Inertias and Gearing, Friction, Joint and Link Flexibility

UNIT 5 Definitions, Point-to-Point Trajectories 6 hours

Definitions, Point-to-Point Trajectories: Straight-Line Paths, Time Scaling a Straight-Line Path, Polynomial Time Scaling, Trapezoidal Motion Profiles, S-Curve Time Scalings, Polynomial Via Point Trajectories

Textbooks:

1. "Modern Robotics: Mechanics, Planning, and Control" (Lynch and Park, Cambridge University Press 2017).
2. Mark W. Spong, Seth Hutchinson, M. Vidyasagar, "Robot Modeling and Control", Wiley, 2012.

References:

1. Niku S B, "Introduction to Robotics, Analysis, Control, Applications", John-Wiley &Sons Inc, 2011

Course Outcomes:

1. Comprehend and interpret various aspects relating to Kinematics of robots .
2. Analyse the Forward and inverse kinematic models of robots.
3. Understand the basic concepts related to flexibility of links and joints.
4. Interpret and conceptualize the functional elements of robot mechanisms.
5. Understand the path control paradigms in robots.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	3	3	2	1					3		2	3
CO2	3	2	2	2	3	2	2					2		3	2
CO3	2	3	2	3	3	2	2					3		2	3
CO4	2	3	2	2	2	2	1					2		2	3
CO5	3	2	3	3	3	3	1					3		3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 ACADEMIC COUNCIL:01-04-2022

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE3521</td><td rowspan="2">ROBOTIC MOTION PLANNING AND CONTROL</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Robot Kintematics and Dynamics</td></tr>
</table>

Course Description:

This course is about motion control and planning for robots. Robot Motion Planning and Control introduces key concepts of robot motion generation: planning a motion for a robot in the presence of obstacles, and real-time feedback control to track the planned motion.

Course Educational Objectives:

- Understand and learn how to implement motion planning and decision-making approaches in robotics.
- Understand the challenges and basic approaches to interleaving planning and execution in robotic systems
- Learn common uses of planning/decision-making in robotics

UNIT 1 Motion Planning-1 10 hours

Overview of Motion Planning, Types of Motion Planning Problems, Properties of Motion Planners, Motion Planning Methods, Configuration Space Obstacles, 2R Planar Arm, Circular Planar Mobile Robot, Polygonal Planar Mobile Robot That Translates, Polygonal Planar Mobile Robot that Translates and Rotates.

UNIT 2 Motion Planning-2 8 hours

Distance to Obstacles and Collision Detection, Graphs and Trees, Graph Search, Complete Path Planners, Grid Methods, Multi-Resolution Grid Representation, Grid Methods with Motion Constraints, Grid-Based Path Planning for a Wheeled Mobile Robot, Grid-Based Motion Planning for a Robot Arm.

UNIT 3 Sampling methods and virtual potential fields 8 hours

Sampling Methods, The RRT Algorithm, The PRM Algorithm, Virtual Potential Fields, A Point in C-space, Navigation Functions, Workspace Potential, Wheeled Mobile Robots, Use of Potential Fields in Planners, Nonlinear Optimization, Smoothing.

UNIT 4 Robot control-1 10 hours

Robot control, Control System Overview, Error Dynamics, Error Response, Linear Error Dynamics, First-Order Error Dynamics, Second-Order Error Dynamics, Motion Control with Velocity Inputs: Motion Control of a Single Joint, Motion Control of a Multi-joint Robot, Task

Space Motion Control. Motion Control with Torque or Force Inputs: Motion Control of a Single Joint, Motion Control of a Multi-joint Robot.

UNIT 5 Robot control-2 9 hours

Task-Space motion Control; Force Control, Hybrid Motion–Force Control: Natural and Artificial Constraints, A Hybrid Motion–Force Controller; Impedance Control, Impedance Control Algorithm, Admittance-Control Algorithm, Low-Level Joint Force/Torque Control.

Text Books:

1. "Modern Robotics: Mechanics, Planning, and Control" (Lynch and Park, Cambridge University Press 2017).

References:

1. "Robotics: Modelling, Planning and Control",1st edition, Bruno Siciliano, Lorenzo Sciavicco,LuigiVillani,GiuseppeOrioloSpringer-Verlag London 2009

Course Outcomes:

1. Understand motion planning problem and C-space.
2. Select the appropriate path planner Algorithms.
3. Understand feedback control for motion control in the joint space.
4. Understand feedback control for motion control in the task space.
5. Will be able to apply concepts learned to force control, hybrid motion–force control, and impedance control..

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	3	3	3	1					3		2	3
CO2	2	3	2	2	2	3	2					2		3	3
CO3	2	2	2	3	3	2	2					2		3	2
CO4	3	2	3	2	3	3	1					3		3	2
CO5	2	3	2	3	3	3	1					3		2	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 ACADEMIC COUNCIL:01-04-2022

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE3531</td><td rowspan="2">ROBOT SIMULATION USING OPEN-SOURCE TOOLS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Robotics</td></tr>
</table>

Course Educational Objectives:

- Understand and learn how to implement general purpose robot simulator(V-REP)
- Understand the core concepts ,elements and usage of robot simulation made with Gazebo
- Wheel robot modelling using Gazebo and ROS.

UNIT 1 V-REP Introduction 10 hours

Introduction - Need for V-REP - user interface - scenes and models - modeling of environment - entities: shapes - joints - dummies - sensors - lights – camera

UNIT 2 V-REP Calculation Modules 8 hours

Distance - collision - forward - inverse - path/motion - geometric constrain Solvers

UNIT 3 V-REP Scripts 8 hours

Main and child scripts - call back scripts - Simulation: Line following of differential wheeled mobile robot - Serial Manipulator – Hexapod.

UNIT 4 Gazebo Animations And Dynamics Control 10 hours

Introduction - Need for gazebo - Core concepts - elements within simulation: world - models - links - joints- sensors - visual objects - collision objects - plug-ins - Element Hierarchy and Types

UNIT 5 Connecting to the Cloud 9 hours

Differential wheeled mobile robot modeling and controlling - Environment Modeling - ROS integration

Textbooks:

1. AnisKoubaa , "Robot Operating System – The complete reference V1", Springer International Publishing, 2016.
2. AnisKoubaa , "Robot Operating System – The complete reference V2", Springer International Publishing, 2017.

3. V-REP user manual, http://www.coppeliarobotics.com/assets/VRepoverviewpresentation.pdf.

References:

1. Lentin Joseph , "Learning Robotics Using Python", Packt Publishing, May 2015.

Course Outcomes:

1. Test the design robot especially the mobility and navigation systems.
2. Write scripts and simulate wheeled mobile robot.
3. Design and simulate wheel robot modelling using Gazebo and ROS.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	2	3	2					2		3	2
CO2	3	2	2	2	3	3	1					2		3	3
CO3	3	2	2	2	2	2	2					3		3	2
CO4	3	3	3	2	3	2	1					3		3	3
CO5	2	3	3	3	2	2	2					3		3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE3541</td><td rowspan="2">ROBOTIC OPERATING SYSTEMS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

ROS is a robotic middleware which offers a collection of packages for commonly used functionality, low level control, hardware abstraction and message passing. ROS is all you need to transition from a hobbyist to a professional developer in the robotics domain!

Course Educational Objectives:

- Understand and learn how to implement motion planning and decision-making approaches using ROS
- Learn the fundamentals behind the open source robotics framework - ROS
- Learn common uses of planning/decision-making in robotics

UNIT 1 Introduction to ROS 10 hours

Introduction - history - distributions - difference from other meta - operating systems - services - ROS framework - operating system – releases

UNIT 2 Introduction to Linux Commands 8 hours

UNIX commands - file system - redirection of input and output - File system security - Changing access rights - process commands - compiling, building and running commands handling variables.

UNIT 3 Architecture of Operating System 10 hours

SFile system - packages - s tacks - messages - services – catkin workspace - working with catkin workspace - working with ROS navigation and listing commands.

UNIT 4 Computation Graph Leve 8 hours

Navigation through file system - Understanding of Nodes - topics - services - messages - bags - master - parameter server - interfacing of Sensors and Actuators

UNIT 5 Debugging and Visualization 9 hours

Debugging of Nodes - topics - services - messages - bags - master parameter - visualization using Gazebo - Rviz - URDF modeling - Xacro - launch files. APPLICATIONS : Navigation stack - tf - sensors - odometer - imu - laser scan - base controller - robot configuration - cost map -

base local planner - global planner - localization - sending goals - tele operation of robot using joystick and mapping

Text Books:

1. Aaron Martinez, Enrique Fernández , "Learning ROS for Robotics Programming", Packt Publishing Ltd, 2013.
2. Jason M O'Kane , "A Gentle Introduction to ROS", CreateSpace, 2013.
3. Jason M O'Kane , "A Gentle Introduction to ROS", CreateSpace, 2013

Course Outcomes:

1. Understand ROS concepts and programming
2. Master the basics of ROS
3. Build distributed software and drivers for a robot
4. Learn to program robots in a professional way

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	3	3	2					3		2	2
CO2	2	2	3	2	2	2	2					3		2	3
CO3	2	3	2	2	2	2	1					2		2	2
CO4	3	2	3	3	3	3	1					2		2	3
CO5	3	2	2	3	3	3	1					3		3	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE3551</td><td rowspan="2">EMBEDDED SYSTEM DESIGN AND DEVELOPMENT</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course introduces the student to the basic concepts and building blocks of Embedded systems Embedded systems are all over homes, offices, cars, factories, hospitals and consumer electronics in today's world. The course describes how the systems are literally embedded in all electronic products, from consumer electronics to office automation, automotive, medical devices and communications. The course explores the methods to make the products smart, connected and are responsible for differentiating the products in the market.

Course Educational Objectives:

- To understand the basic concepts, building blocks of embedded systems.
- To explore the fundamentals on board and external bus communication in embedded systems.
- To discuss the embedded software tools, different phases and modeling of embedded system.
- To develop on processor scheduling algorithms, basics of real time operating system.
- To familiarize the concepts required to make the products smart.

UNIT 1 Introduction To Embedded Systems 8 hours

Embedded systems vs general computing systems, history of embedded systems, classification of embedded systems, major application of embedded systems, purpose of embedded systems, elements of an embedded systems, core of the embedded systems, memory.

UNIT 2 Communication buses in embedded systems 8 hours

On board communication interfaces,I2C ,SPI bus, 1Wire bus, parallel interface, external communication interfaces, RS-232, RS485, USB,IEEE 1394 fire wire bus, IrDA, bluetooth, Wi-Fi, zigbee.

UNIT 3 Software Development Tools 8 hours

Main and child scripts - call back scripts - Simulation: Line following of differential wheeled mobile robot - Serial Manipulator – Hexapod.

UNIT 4 Introduction to real-time operating systems 6 hours

A brief history of operating systems, defining an RTOS, the scheduler, introduction to task, task states and scheduling, round-robin scheduling algorithm, co-operative scheduling algorithm, preemptive scheduling algorithm, introduction to semaphores.

UNIT 5 Embedded system application development 6 hours

Objectives, different phases and modeling of the embedded product development life cycle (EDLC), case studies on smart card- adaptive cruise control in a car -mobile phone software for key inputs.

Text Books:

1. Rajkamal, Embedded system-Architecture, Programming, Design, 3e, TMH, 2017.
2. Shibu. K. V., Introduction to Embedded Systems, Tata McGraw Hill, 2017

References:

1. Peckol, Embedded system Design, John Wiley & Sons, 2010
2. Lyla B Das, Embedded Systems-An Integrated Approach, Pearson,2013

Course Outcomes:

After successful completion of this course, the student will able to

1. Understand the software tools required to develop an embedded systems (L1).
2. Describe the differences between the general computing system and the embedded system, the classification of embedded systems (L3).
3. Design real time embedded systems using the concepts of RTOS (L5).
4. Design a system component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability (L5).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	3	2	2	1					3		3	2
CO2	3	2	2	3	2	2	1					2		3	2
CO3	2	3	3	3	2	3	1					3		3	2
CO4	2	3	2	3	2	3	2					2		3	2
CO5	2	2	2	3	2	2	1					3		2	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

EECE3561	COMPUTER VISION	L	T	P	S	J	C
		3	0	2	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides an overview of computer vision. Camera models, multi-view geometry, reconstruction, some low-level image processing, and high-level vision tasks such as picture categorization and object identification are all covered.

Course Educational Objectives:

- Introduce the fundamental problems of computer vision
- To support further research in this field, provide a grasp of the methodologies, mathematical ideas, and algorithms employed in computer vision.
- Provide pointers into the literature and exercise a project based on a literature search and one or more research papers.
- Practice software implementation of different concepts and techniques covered in the course.
- Utilize programming and scientific tools for relevant software implementation.

UNIT 1 **Image Processing And Transforms** **8 hours**

Introduction, Applications, operations on Images Smoothing - Image Morphology - Flood Fill - Resize - Image Pyramids – Image Transforms: Convolution - Gradients and Sobel Derivatives - Laplace - Canny - Hough Transforms – Remap - Stretch - Shrink - Warp - and Rotate - Cart to Polar and Polar to Cart - Log Polar - DFT - DCT - Integral Images – Distance Transform - Histogram Equalization Threshold.

UNIT 2 **Contours, Segmentation, Tracking And Motion** **8 hours**

Parts and Segments - Background Subtraction – Watershed Algorithm Image Repair by Inpainting - The Basics of Tracking - Corner Finding - Subpixel Corners - Invariant Features - Optical Flow - Mean - Shift and Camshift Tracking.

UNIT 3 **Camera Calibration and 3d Vision** **8 hours**

Camera Model - Calibration - Undistortion - Rodrigues Transform - Projection3D Pose Estimation - Stereo Imaging - Structure from Motion - Fitting Lines in Two and Three Dimensions.

UNIT 4 **Low Level, High level Vision Algorithms & Object Recognition** **8 hours**

Image representation, image subtraction, image averaging, Segmentation, Thresholding, Object recognition, Approaches to Object Recognition, Recognition by combination of views

UNIT 5 Robot Vision 8 hours

Basic introduction to Robotic operating System (ROS) - Real and Simulated Robots - Introduction to OpenCV, Open NI and PCL, installing and testing ROS camera Drivers, ROS to OpenCV – The cv_bridge Package.

Text Books:

1. Computer Vision by Linda Shapiro and George Stockman, Prentice Hall, Year: 2001
2. JayneilDalal& Sohil Patel , "Instant OpenCV Starter: Get Started With OpenCV Using Practical Hands-On Projects", 1st Edition, Shroff/Packt, 2013
3. R.Patrick Goebel, “ ROS by Example: A Do-It-Yourself Guide to Robot Operating System – Volume I”, A Pi Robot Production, 2012.
4. Bernd Jahne, “Digital Image Processing”, Springer Publication, 2013

References:

1. Digital Image processing – R.C. Gonzalez & R.E. Woods, Addison Wesley, Pearson Ed., 2nd Education, 2002
2. Fundamentals of Digital Image processing – A.K.Jain, Prentice Hall of India
3. Digital Image processing using MAT LAB – Rafael C. Gonzalez, Richard EWoods and Steven L. Edition, PEA, 2004
4. Digital Image Processing – William K. Pratt, John Wiley, 3rd Edition, 2004

Course Outcomes:

1. Perform various image processing operations like image morphology , resizing and image transforms
2. Understand about the contours, segmentation and tracking Analyze various camera models and calibration.
3. Develop programs for different low level, high level vision algorithms
4. Understand the basic operation of the Robotic Operating System (ROS)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	1	3	3							2		2	3
CO2	1	2	2	3	3							2		2	3
CO3	1	2	1	3	2							3		3	3
CO4	2	2	2	3	2							2		3	3
CO5	2	2	2	3	2							3		3	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 ACADEMIC COUNCIL:01-04-2022

SDG No. & Statement:

SDG Justification:

EECE4141	INTRODUCTION TO AI IN ROBOTICS	L	T	P	S	J	C
		3	0	2	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course enables the students to think critically about what makes humans intelligent, and how computer scientists are designing computers to act more like us Artificial Intelligence (AI) is the study of how to make computers make things which at the moment people do better especially in Robotics arena. The primary objective of this course is to provide an introduction to the basic principles and applications of Artificial Intelligence and how it is useful in design and development of Robotics systems. Upon successful completion of the course, students will have an understanding of the basic areas of Artificial Intelligence - problem solving, search mechanisms, constraint satisfaction, and knowledge representation using logic, reasoning and their applications.

Course Educational Objectives:

- The fundamentals of Artificial Intelligence, the concept of Intelligent Agents and problem-solving process through uninformed and informed searches.
- How to gain an insight into competitive environments and robot paradigms.
- Viewing many problems in AI as Multiagent scenarios.
- To familiarize concepts of Path planning.
- To acquire the knoledge of localization in the view of Robotics.

UNIT 1 Introduction 8 hours

Introduction To AI And Intelligent Agents : Foundations, History - Intelligent agents, Agents - Nature of Environments, Structure of agents - Problem solving agents - Problem formulation - State space, Search space - Problem reduction - Searching for solutions: Uninformed search strategies – Informed search strategies - Heuristic functions.

UNIT 2 Robotic Paradigms – I 8 hours

Overview of the Three Paradigms - Hierarchical Paradigm: attributes – representative architectures - Reactive paradigm: attributes - subsumption architecture - potential field methodologies - Designing a reactive implementation: a primitive move-to-goal behavior, an abstract follow-corridor behavior - Designing a Reactive Behavioral System.

UNIT 3 Robotic Paradigms II 8 hours

The Hybrid Deliberative/Reactive Paradigm- Attributes - Architectural Aspects- Managerial Architectures- State-Hierarchy Architectures Model-Oriented Architectures – Multi Agents: Overview – Heterogeneity – Control – Cooperation – Emergent Social Behaviour.

UNIT 4 Topological And Metric Path Planning 8 hours

Landmarks and gateways - relational methods – associative methods - case study - Metric Planning: Configuration Space-Cspace representations - graph based planners - wavefront based planners - Interleaving Path Planning and Reactive Execution.

UNIT 5 Localization And Map Making 8 hours

Sonar sensor model - Bayesian – Dampster-Shafer theory - HIMM - comparison of methods - localization – exploration.

Textbooks:

1. Robin R. Murphy, "Introduction to AI Robotics", MIT Press, 2000.
2. Start Russell, Peter Norvig, "Artificial Intelligence – A Modern Approach", Pearson Education, New Delhi, 2015

References:

1. Francis X. Govers, "Artificial Intelligence for Robotics", Packt, 2018.
2. Roland Siegwart, Illah R. Nourbakhsh , "Introduction to Autonomous Mobile Robots", MIT Press, 2004
3. Kevin Knight, Elaine Rich, Nair , "Artificial Intelligence", Tata McGraw Hill, New Delhi, 2017
4. Jon Gabriel, "Artificial Intelligence: Artificial Intelligence for Humans", 1 st Edition, Createspace Independent Publishers, 2016

Course Outcomes:

1. Solve various search problems
2. Contrast hierarchical and reactive paradigms
3. Demonstrate multi-agent scenarios of robot design
4. Apply concepts of metric plalning in design process of robos
5. Determine dampstershafer theory and HMM models

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	3	2							2		3	3
CO2	3	2	3	2	3							3		3	3
CO3	2	2	2	2	3							3		2	3
CO4	2	3	3	2	3							3		2	2
CO5	3	2	3	2	2							3		3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 ACADEMIC COUNCIL:01-04-2022

SDG No. & Statement:
SDG Justification:

<table>
<tr><td rowspan="2">EECE4151</td><td rowspan="2">INTRODUCTION TO ML IN ROBOTICS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

Machine Learning is a flourishing subject in Computer Science which devises models that can automatically learn from data and detect patterns from data. The applications of machine learning are diverse ranging from self-driven cars to disaster management systems. With easy availability of data from different devices and measurements, machine learning techniques become imperative in analysing trends hidden in the data. This course focuses on the major tasks of machine learning viz., supervised, unsupervised learning and reinforce learning approaches that can robustly address non linear, noisy as well as high-dimensional in natured data that is perceived by the intelligent machines.

Course Educational Objectives:

- Introduce the concepts of machine learning and the complete process model for working with real data wihuncertainity.
- Impart the various approaches to supervised learning.
- Demonstrate unsupervised learning approaches.
- Illustrate the performance of reinforcemnetleanringtechinques for intlliegent machines.
- Differentiate between shallow and deep neural networks by considering various case studies.

UNIT 1 Introduction 8 hours

Introduction to Machine learning, types of Machine learning, supervised, unsupervised, basic concept of machine learning. Gaussian Model: Introduction, Gaussian discernment analysis, Quadratic discriminant analysis, Liner discriminant analysis.

UNIT 2 Foundations Of Supervised Learning & Advanced Supervised Learning 8 hours

Decision trees and inductive bias – Geometry and nearest neighbors – Logistic regression – Perceptron – Binary classification, Linear models and gradient descent – Support Vector machines – Naïve Bayes models and probabilistic modeling – Model selection and feature selection – Model Complexity and Regularization.

UNIT 3 Unsupervised Learning 8 hours

Clustering – K-means – Expectation Maximization Algorithm – Gaussian Mixtures, anomaly detection, selecting number of clusters, Bayesian Gaussian Mixture Models, anomaly and novelty detection algorithms. Curse of dimensionality, Dimensionality Reduction, PCA

UNIT 4 Reinforcement learning 8 hours

Markov Decision Process - Temporal Difference Learning - Function Approximation

UNIT 5 Neural Networks and applications 8 hours

From biological to artificial neurons, implementing MLPs with Keras, fine tuning neural network hyperparameters. Case Study of the effectiveness of the Bias-variance. Case study on Obstacle avoidance and navigation of a mobile robot – Case study on Use of stochastic PCA and the PCA neural network to find low dimensional features. Building a feed-forward neural network to ascertain automatic navigational queries.

Textbooks:

1. Kevin P. Murphy , "Machine Learning – A Probabilistic Perspective", The MIT Press, 2010.
2. EthemAlpaydin , "Introduction to Machine Learning", The MIT Press, 2004.
3. Michalski, Carbonell, Tom Mitchell, 'Machine Learning', Springer, 2014.
4. Peter Flach, 'Machine Learning: The Art and Science of Algorithms that make sense of data', Cambridge, 2014.

References:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman , "The Elements of Statistical Learning: Data Mining, Inference, and Prediction", Springer, 2010.
2. Ian Good fellow, YoshuaBengio, Aaron Courville , "Deep Learning", MIT Press, 2012.
3. Tom M Mitchell , "Machine Learning", Mc Graw Hill, 2017.
4. Gilbert Strang , "Linear Algebra and Learning from data", 2019.

Course Outcomes:

1. Demonstrate basic machine learning approach using real world data.
2. Apply supervised learning models to make good predictions.
3. Illustrate various clustering techniques.
4. Apply function approximation for adoptabity of learning.
5. Show the working of neural networks in the view of robotic applications.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	3							3		2	3
CO2	3	3	2	3	2							3		2	3
CO3	2	2	2	3	3							3		2	3
CO4	3	2	2	3	2							3		2	3
CO5	2	3	3	3	2							3		3	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE3571</td><td rowspan="2">SMART GRID ARCHITECTURAL DESIGN</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">EECE3081: Electrical Power Generation Transmission and Distribution</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course is aimed to introduce the basic concepts of smartgrid which are needed for the design and development of smartgrid power system networks and has potential applications in electrical power system network development. This is base course for subjects like smartgrid communication systems, energy management in smartgrids. The students are provided with theorital concepts of smart grid architecture and its design.

Course Educational Objectives:

- To familiarize power system networks and fundamentals of smart grid.
- To understand the basic architecture of smart grid.
- To teach the concepts of design for smart grid.
- To familiarize concepts of communication network architecture for smart grid
- To acquire power system parameters for evaluation of smart grid network.
- To solve the problems associated with the design and development of smart grid networks.

UNIT 1 Introduction to smart grid 8 hours

Basics of power systems, definition of smart grid, need for smart grid, smart grid domain, enablers of smart grid, smart grid priority areas, regulatory challenges, smart-grid activities in India.

UNIT 2 Smart grid architecture 8 hours

Smart grid architecture, standards-policies, smart-grid control layer and elements, network architectures, IP-based systems, power line communications, supervisory control and data acquisition system, advanced metering infrastructure. The fundamental components of Smart Grid designs, Transmission Automation, Distribution Automation, Renewable Integration.

UNIT 3 Introduction to smart grid design 8 hours

Approach to Designing the Smart Grid, Challenges to Smart Grid Development, Top-Down and Bottom-Up Design Approaches, Bottom-Up Smart Grid Design and Smart Grid Top-down Design.

UNIT 4 Communication network architectures for the smart grid 8 hours

Architecture Framework, Core-Edge Architecture, Smart Grid Network Protocols, Wide Area Networks for Smart Grids, Local Traffic Aggregation, Field Area Networks and Transmission Management System (TMS).

UNIT 5 Smart Grid Network Design Process 6 hours

Network Traffic, Smart Grid Traffic, Characterization, Traffic Aggregation and Routing Architecture, Network Performance, Delay and priority requirements for Smart Grid applications, QoS Considerations in Smart Grid Networks, Differentiated Services for Smart Grid Application Functions and Smart Grid Network Reliability.

Textbooks:

1. Ali Keyhani, Mohammad N. Marwali, Min Dai, “Integration of Green and Renewable Energy in Electric Power Systems”, Wiley
2. Clark W. Gellings, “The Smart Grid: Enabling Energy Efficiency and Demand Response”, CRC Press.
3. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, “Smart Grid: Technology and Applications”, Wiley

References:

1. Jean Claude Sabonnadiere, NouredineHadjsaid, “Smart Grids”, Wiley Blackwell 19. Stuart Borlase, “Smart Grids (Power Engineering)”, CRC Press.

Course Outcomes:

1. Solve various smartgrid networks single line diagrams.
2. Examine the behavior of smartgrid network for power flow.
3. Calculate voltage, current, real power, reactive power and power factor in smartgrid networks with sinusoidal excitation.
4. Apply concepts of design and architectural concepts for smart grid networks.
5. Determine the various power system parameters for design of the smartgrid networks.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	3							2	2	3
CO2	2	2	2	3	3	2							2	2	3
CO3	2	2	2	2	2	2							2	3	3
CO4	3	3	3	3	3	2							2	3	2
CO5	3	2	2	2	2	3							3	3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

EECE3581	FUNDAMENTALS OF POWER SYSTEMS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

In this course it is aimed to introduce to the students the working principles of various power generating sources, transmission and distribution of power in practical power systems. The basic concepts of solar energy, wind energy, biomass energy, geothermal energy and ocean energy are explained. Transmission line modelling parameters, fault conditions and mechanical conditions of transmission lines are analysed

Course Educational Objectives:

- To Study various basic concepts of conventional power sources
- To Expose various basic concepts of renewable energy sources.
- To Familiarize various parameters in transmission lines
- To Interpret the effect of sag and usage of underground cables
- To Expose various AC and DC distributions systems

UNIT 1 Conventional Power Generation Hydroelectric Power Generation 8 hours

Plant layout, working of hydroelectric power plant and selection of site. Thermal Power Generation: Plant layout, working of thermal power plant and selection of site. Nuclear Power Generation: Plant layout, working of nuclear power plant and selection of site.

UNIT 2 Renewable Energy Sources Solar Power Generation 6 hours

Physical principles of conversion of solar radiation into heat, working principle of Flat plate collectors and Photovoltaic Cell. Wind power generation: Basic components of Wind energy conversion systems, working principle of HAWT and VAWT. Energy from Biomass: Biomass conversion technologies, working principle of Floating drum and fixed dome plants. Geothermal energy: Working principle of Vapor and Liquid dominated systems Energy from Oceans: Working principle of closed cycle OTEC. Basic components of Tidal power plant

UNIT 3 Transmission line Parameters Overhead Transmission Lines 8 hours

Capacitance and Inductance calculations for single phase two wire line, three phase lines, proximity effect, skin effect. Sinusoidal Steady state representation of Lines: Short, medium, and long lines, Characteristics of transmission lines. Surge Impedance Loading.

UNIT 4 Mechanical design of overhead lines Sag and insulators. 8 hours

Line supports, insulators, voltage distribution in suspension-type insulators. Testing of insulators, String efficiency, tension and sag calculation, effects of wind and ice loading. Underground cables: Comparison with overhead line. Types of cables, Insulation resistance, potential gradient, Capacitance of single core cables. Corona: Formation of corona. Critical voltages, effect on line performance.

UNIT 5 Distribution Systems 6 hours

Overview of Distribution systems, Types of DC & AC Distributors: Radial, and Ring systems. Voltage drop calculation with concentrated loads and uniformly distributed loads.

Textbooks:

1. “Generation, Distribution and Utilization of Electrical Energy” - C.L.Wadwa. (New Age International, 1989, Reprint edition 2005.
2. “Chakrabarti A., Soni M.L., Gupta P.V., and Bhatnagar U.S., 'A text book on Power Systems Engg.', Dhanpat Rai and Sons, New Delhi, 2nd revised edition, 2010.
3. J.B.Gupta, ‘A course in Power Systems’, S.K.Kataria and sons, reprint 2010-2011.

References:

1. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “Electric Power Systems”, Wiley,2012.

Course Outcomes:

1. Understand power generating techniques by various sources (L1).
2. Identify various renewable energy sources for power generation(L3).
3. Estimate the various parameters in transmission lines(L5)
4. Appraise the effect of sag on transmission lines(L5)
5. Assess various AC and DC distribution systems for concentrated and uniformly distributed loads(L5)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	3	2		1						1	2		
CO2	2	2	3	3		1						1	3		
CO3	3	1	3	3		2						2	2		
CO4	3	2	3	3		2						1	2		
CO5	3	2	3	3		1						1	3		

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE3591</td><td rowspan="2">RENEWABLE ENERGY SYSTEMS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

To impart knowledge of renewable Energy Sources and technologies and sufficient inputs on a variety of issues in harnessing renewable Energy by recognize current and possible future role of renewable energy sources.

Course Educational Objectives:

- To Study various basic concepts of renewable sources of energy
- To understand the operating principles of Wind energy conversion.
- To Evaluate the control methods used in PV and Wind energy systems.
- To understand the operating principles of biomass.
- To know various energy sources.

UNIT 1 Renewable Energy Sources 8 hours

Environmental consequences of fossil fuel use, Importance of renewable sources of energy, Sustainable Design and development, Types of RE sources, Limitations of RE sources, Present Indian and international energy scenario of conventional and RE sources.

UNIT 2 Wind Energy 6 hours

Power in the Wind – Types of Wind Power Plants (WPPs)–Components of WPPs-Working of WPPs- Siting of WPPs-Grid integration issues of WPPs.

UNIT 3 Solar PV and Thermal Systems 8 hours

Solar Radiation, Radiation Measurement, Solar Thermal Power Plant, Central Receiver Power Plants, Solar Ponds. Thermal Energy storage system with PCM- Solar Photovoltaic systems: Basic Principle of SPV conversion – Types of PV Systems- Types of Solar Cells, Photovoltaic cell concepts: Cell, module, array, PV Module I-V Characteristics, Efficiency & Quality of the Cell, series and parallel connections, maximum power point tracking, Applications.

UNIT 4 Biomass energy 8 hours

Introduction-Biomass resources –Energy from Bio mas: conversion process, Biomass Cogeneration-Environmental Benefits. Geothermal Energy: Basics, Direct Use, Geothermal Electricity. Mini/micro hydro power: Classification of hydropower schemes, Classification of water turbine, Turbine theory, Essential components of hydroelectric system.

UNIT 5 Other Energy Sources 6 hours

Tidal Energy: Energy from the tides, Barrage and Non-Barrage Tidal power systems. Wave Energy: Energy from waves, wave power devices. Ocean Thermal Energy Conversion (OTEC)- Hydrogen Production and Storage- Fuel cell: Principle of working- various types – construction and applications. Energy Storage System- Hybrid Energy Systems.

Text Books:

1. Bin_Wu,_Yongqiang_Lang, _Navid_Zargari,_Samir_Kour,"Power Conversion and Control of Wind Energy Systems", IEEE Press Series on Power Engineering, John Wiley and SonsLtd.,2011.
2. S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill, 1984.
3. G. M. Masters, "Renewable and Efficient Electric Power Systems", John Wiley and Sons, 2004.
4. G.D. Rai, "Non-conventional Energy Sources", Khanna Publishers.

References:

1. H. Siegfried and R. Waddington, "Grid integration of wind energy conversion systems" John Wiley and Sons Ltd.,2006.
2. G. N. Tiwari and M. K. Ghosal, "Renewable Energy Applications", Narosa Publications,2004. J. A. Duffie and W. A. Beckman, "Solar Engineering of Thermal Processes", John Wiley & Sons,1991

Course Outcomes:

1. Understand power generating techniques by various renewable sources (L1).
2. Identify various renewable energy sources for power generation(L3).
3. Develop and design PV and wind models(L3)
4. Analyse biomass energy conversion and operation (L4)
5. Interpret various energy sources(L5)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2		2	2					2		2
CO2	3	3	3	3	2		2	1					2		3
CO3	2	2	2	2	2		2	1					3		2
CO4	2	3	2	3	2		3	1					3		2
CO5	2	3	3	3	2		3	1					2		3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE3601</td><td rowspan="2">SMART GRID COMMUNICATION SYSTEMS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">EECE3221: Internet of Things</td></tr>
</table>

Course Description:

This course is aimed to introduce the basic concepts of smart grid communication systems which are needed for the communication in smart grid power system networks and has potential applications in smart grid communication systems development. This is base course for subjects like smart grid architectural design, energy management in smart grids. The students are provided with theoretic concepts of smart grid communication technologies.

Course Educational Objectives:

- To familiarize communication technologies for power system.
- To understand the information systems for control centres.
- To teach the concepts of Integration, Control and Operation of Distributed Generation
- To familiarize concepts of smart metering.
- To acquire smart grid parameters for monitoring of smart grid network.
- To solve the problems associated with the communication systems of smart grid networks.

UNIT 1 Communication Technologies for Power System 8 hours

Fibre Optical Networks, WAN based on Fibre Optical Networks, IP based Real Time data Transmission, Substation communication network, Zigbee.

UNIT 2 Information System for Control Centres (ICCS) 6 hours

ICCS Configuration, ICCS communication Network, ICCS Time Synchronization, ECommerce of Electricity, GIS, GPS.

UNIT 3 Integration, Control and Operation of Distributed Generation 8 hours

Distributed Generation Technologies and its benefits, Distributed Generation Utilization Barriers, Distributed Generation integration to power grid.

UNIT 4 Smart metering 8 hours

Load dispatch centres, wide area monitoring system (WAMS), PMU; Smart sensors/telemetry, advanced metering infrastructure (AMI), smart metering

UNIT 5 Smart grid system monitoring 6 hours

communication infrastructure and technologies; self-healing. Micro grid: Integration of distributed energy sources; concept, operation, control, and protection of Micro grid. Integration of conventional and non-conventional energy sources.

Text Books:

1. Ali Keyhani, Mohammad N. Marwali, Min Dai, “Integration of Green and Renewable Energy in Electric Power Systems”, Wiley.
2. Clark W. Gellings, “The Smart Grid: Enabling Energy Efficiency and Demand Response”, CRC Press.

References:

1. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, “Smart Grid: Technology and Applications”, Wiley.
2. Jean Claude Sabonnadiere, NouredineHadjsaid, “Smart Grids”, Wiley Blackwell 19. 5. Stuart Borlase, “Smart Grids (Power Engineering)”, CRC Press.

Course Outcomes:

1. Solve various smart grid communication topologies (L3).
2. Examine the behaviour of smart grid network by means of information from control centres(L4).
3. Calculate the power system parameters for distributed generation(L3).
4. Apply concepts of smart metering for monitoring of smart grid networks(L5).
5. Determine the various power system parameters for design of communication networks for smart grid networks (L3).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	2	3	2							3	2	3
CO2	2	2	3	2	3	2							3	2	2
CO3	3	2	3	3	2	3							3	2	2
CO4	2	3	2	2	3	2							2	2	3
CO5	3	3	3	2	3	3							2	2	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS: 27-12-2021 ACADEMIC COUNCIL:01-04-2022

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE4161</td><td rowspan="2">ENERGY MANAGEMENT IN SMART GRIDS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">EECE3081: Electrical Power Generation Transmission and Distribution</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course is aimed to introduce the basic concepts of smart grid energy management systems which are needed for the energy monitoring and management in smart grid power system networks and has potential applications in smart grid energy development. This is base course for subjects like smart grid architectural design, smart grid communication systems. The students are provided with theorital concepts of smart grid energy management techniques.

Course Educational Objectives:

- To familiarize energy management technologies for power system.
- To understand the smart metering for energy management.
- To teach the concepts of Energy management of smart transmission systems
- To familiarize concepts of Energy management of smart distribution systems
- To acquire smart grid parameters for Design of Energy Management Systems for smart grid

UNIT 1 Introduction 8 hours

Early smart grid initiatives, overview of the technologies required for the smart grid, information security for the smart grid.

UNIT 2 Smart metering for energy management 6 hours

Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading (AMR), Outage Management System (OMS), Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation.

UNIT 3 Energy management of smart transmission systems 8 hours

optimization, utilization of large-scale wind and solar power, flexible loads in demand response. Fluctuation of load and wind power output, impact of mediation of electric vehicles and renewable energy sources into a smart grid, scheduling the thermal units along with the electric vehicles and renewable energy sources.

UNIT 4 Energy management of smart distribution systems 8 hours

Introduction, evolution of electricity metering, key components of smart metering, overview of the hardware used for smart meters, smart metering protocols.

UNIT 5 Design of Energy Management Systems 6 hours

SCADA, System design of WAMPAC systems, Wide Area Monitoring and State Estimation, Real-time Diagnostics and Situational Awareness, energy management Planning Issue, Diagnostics, Self-Healing and Reliability of Smart Grids, Demand Response Management through Smart Grid Technology, System Identification Technologies with PMUs.

Textbooks:

1. Nick Jenkins, Janaka Ekanayake, [et al.] Smart Grid Technology and Applications, Wiley India Ltd.
4. Ali Keyhani, Muhammad Marwali, Smart Power Grids 2011, Springer-Verlag Berlin Heidelberg 2012.

References:

1. Ali Keyhani, Design of Smart Power Grid Renewable Energy Systems, Wiley-IEEE Press 2016.Unit I: Communication Technologies for Power System

Course Outcomes:

1. Solve various topologies for energy management (L3).
2. Examine the behaviour of smart grid network by means of energy monitoring(L4).
3. Calculate the power and energy for smart grid networks(L3).
4. Apply concepts of smart metering for energy management of smart grid networks(L5).
5. Determine the various power system parameters for design of energy management solution for smart grid networks (L3).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	2	3							2	2	2
CO2	3	2	3	3	3	3							3	2	2
CO3	2	2	3	3	3	2							3	2	2
CO4	2	2	2	3	2	3							2	3	2
CO5	2	2	2	3	3	2							3	3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

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BOS: 27-12-2021 ACADEMIC COUNCIL:01-04-2022

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE3611</td><td rowspan="2">SECURITY ISSUES IN SMART GRIDS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

In this course it is aimed to introduce to the students the knowledge of various cyber security terminologies, technologies, protocols, threat analysis, security principles, security mechanisms, policies, forensics, incidence response and methods/practices to secure systems etc.

Course Educational Objectives:

- To Study fundamentals of the cybersecurity domain and related issues
- To Expose various basic concepts of cyber security terminologies, technologies
- To Familiarize various protocols of cyber security
- To Interpret the effect of security principles, security mechanisms
- To Expose various policies, forensics of cyber security

UNIT 1 Introduction 8 hours

Introduction, Psychology, Usability, Thinking like a Hacker CIA Triad, Security Terminologies, Security Protocols Security Policies and Management, Multilevel and multilateral Policies, Security Mechanisms

UNIT 2 Software security 6 hours

Security Design Principles, Threat Analysis and Risk Assessment, Securing a System Cryptography, Basic Techniques, Digital Signatures, Cryptanalysis Software Security, Lowlevel attacks, Code Review and Testing, Defences

UNIT 3 Network security 8 hours

Fall-Break, Student Project Idea Discussion Network Security, Vulnerabilities, Attacks, Defences Internet and Smartphone Security, Anonymous vs Secure Browsing

UNIT 4 Cyber security applications 8 hours

Information Economics, Economics of Security, Physical Protection, Biometrics Banking Security, Cyber Forensics, Cyber Warfare, Surveillance and Privacy

UNIT 5 Issues and ethics 6 hours

Incident Response and Mitigation, Business Continuity, Legal issues and Ethics

Text Books:

1. Ross Anderson, Security Engineering. 2nd Edition. John Wiley and Sons. 2008, ISBN-13: 978-0470068526, Required.
2. Web Technologies: HTML, JAVASCRIPT, PHP, JAVA, JSP, XML and AJAX, Black Book bykogentleanrning solutions, published by dreamtech.
3. XML: The Complete Reference –(by Williamson Heather published by Osborne publications 1/e)

References:

1. Charles P. Pfleeger, Security in Computing, 5^{th} Edition, Prentice Hall, 2015, ISBN-10: 0134085043, Recommended.
2. Jason Hunter, William Crawford, Java Servlet Programming, 2/e, O'Reilly, 2003
3. Robert W.Sebesta, Programming the World Wide Web, 4/e,Pearson Education, 2007.

Course Outcomes:

1. Solve various problems for cybersecurity domain and related issues(L3).
2. Examine the behaviour of cyber security terminologies, technologies (L4).
3. Calculate the network security parametersL3).
4. Apply concepts of various policies and forensics(L5).
5. Determine the various threats associated with cybercrime (L3).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	3							3		3	3
CO2	1	2	1	3	2							3		2	3
CO3	2	2	2	2	3							2		2	2
CO4	2	2	2	3	3							3		3	2
CO5	1	3	1	3	3							2		3	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

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BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE3621</td><td rowspan="2">INTRODUCTION TO ELECTRIC VEHICLE TECHNOLOGY</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

UNIT 1 **Introduction** **8 hours**

Air pollution, global warming, petroleum resources, induced costs, and development strategies for future oil supply, Overview of Past, current and future of electric vehicles.

UNIT 2 **Vehicles' classification** **8 hours**

Classification of vehicles: Conventional IC engines, electric vehicles, hybrid electric vehicles, plug-in hybrid vehicles, and fuel cell vehicles. Basic principles and operation of electric vehicles.

UNIT 3 **Configuration and Architecture** **8 hours**

Configuration of electric vehicles, performance of electric vehicles: traction motor characteristics, requirement of tractive and transmission effort and energy consumption. Architecture of hybrid vehicles: series and parallel.

UNIT 4 **Basic electric propulsion systems** **8 hours**

(Elementary treatment only) Principle, operation and performance of DC motors, induction motors, brushless DC motors and switched reluctance motors

UNIT 5 **Overview of communication in EVs** **8 hours**

Vehicle to grid communication, vehicle to vehicle communications, and grid to vehicle communication

Textbooks:

1. Ehsani, M., Gao, Y., Longo, S., & Ebrahimi, K. M. (2018). Modern electric, hybrid electric, and fuel cell vehicles. CRC press.
2. Larminie, James, and John Lowry. Electric vehicle technology explained. John Wiley & Sons, 2012.

References:

1. Lu, J. and Hossain, J., 2015. Vehicle-to-grid: linking electric vehicles to the smart grid. Institution of Engineering and Technology.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	3	2		2	1					3		2
CO2	3	3	2	2	2		2	2					2		2
CO3	3	3	2	2	2		3	2					3		3
CO4	3	2	3	2	3		2	1					2		3
CO5	2	3	2	3	2		3	2					2		2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

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SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE3631</td><td rowspan="2">SENSORS AND COMMUNICATIONS IN ELECTRIC VEHICLES</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">EECE3221: Internet of Things</td></tr>
</table>

UNIT 1 **Sensors: 1** **8 hours**

Concepts of Hall effect sensors, piezoelectric sensors, optical sensors, ultrasonic sensors. Position sensor, velocity sensor, acceleration sensor, linear variable displacement sensors, inertial sensors (gyros, accelerometers)

UNIT 2 **Sensors: 2** **8 hours**

Temperature sensor, voltage sensor, current sensor, MEMS, tire pressure sensors, wireless sensors, level sensor, occupancy sensor, image sensor, LIDAR, RADAR, GNSS.

UNIT 3 **Communications in EV-1** **8 hours**

Data transmission types and modes, wired communication protocols - ethernet, CAN, Modbus, UART. Wireless communication protocols (elementary treatment only).

UNIT 4 **Communications in EV-2** **8 hours**

Vehicle to grid communication, overall flow of communication, ISO communication standards: ISO 15118 (series 1, 2, 3, 5 and 5).
SAE Recommended Practice J2836/1, SAE Recommended Practice J2847/1, SAE Surface Vehicle Recommended Practice J1772.

UNIT 5 **Charging protocols:** **8 hours**

Open Charge point protocol, open charge point interface, open automated demand response, open smart charging protocol, open clearing house protocol, open interchange protocol, eMobility interoperation protocol

Text Books:

1. Basu, A.K., Tatiya, S. and Bhattacharya, S., 2019. Overview of electric vehicles (EVs) and EV sensors. In Sensors for Automotive and Aerospace Applications (pp. 107-122). Springer, Singapore.
2. IEC/ISO 15118-1: 2013, 2013. Road vehicles–vehicle to grid communication interface–part 1: general information and use-case definition.

References:

1. Pratt, R.M., Tuffner, F.K. and Gowri, K., 2011. Electric Vehicle Communication Standards Testing and Validation Phase I: SAE J2847/1 (No. PNNL-20913). Pacific Northwest National Lab.(PNNL), Richland, WA (United States).
2. https://www.kpit.com/insights/smart-charging-vehicle-to-gridcommunication/
3. https://driivz.com/blog/ev-charging-standards-and-protocols/

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	2		3	1					3		3
CO2	3	3	2	2	2		3	2					3		3
CO3	3	2	2	2	2		3	1					3		3
CO4	2	2	2	3	2		3	2					3		3
CO5	3	2	2	2	2		3	2					3		2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

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BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE3641</td><td rowspan="2">VEHICLE DYNAMICS, MODELING AND SIMULATIONS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

UNIT 1 **Introduction** **8 hours**

Vehicle movement, vehicle resistance – rolling resistance, aerodynamic drag and grading resistance. Dynamic equation, vehicle power plant and transmission characteristics, vehicle performance – maximum speed of a vehicle, acceleration performance

UNIT 2 **Fuel Economy** **8 hours**

Operating fuel economy – fuel economy characteristics of internal combustion engines, calculation of vehicle fuel economy. Braking performance – braking force, braking distribution

UNIT 3 **Kinematics** **8 hours**

Coordinate Systems, active safety systems, equations of motion – ground vehicles, quarter car model – kinematics, force and torques and simulation

UNIT 4 **Road and tire models** **8 hours**

Deterministic and random profiles of a road. Tire development, forces and torques, typical tire characteristics, contact geometry, steady-state forces and torques. First order tire dynamics and simulation.

UNIT 5 **Lateral and longitudinal dynamics** **8 hours**

Kinematic tire model, Ackermann geometry, vehicle model with trailer, steady-state cornering.
Dynamic wheel loads, maximum acceleration, driving and braking, anti-lock system, drive and brake pitch.

Text Books:

1. Ehsani, M., Gao, Y., Longo, S. and Ebrahimi, K.M., 2018. Modern electric, hybrid electric, and fuel cell vehicles. CRC press.
2. Rill, G. and Castro, A.A., 2020. Road Vehicle Dynamics: Fundamentals and Modeling with MATLAB®. CRC Press.

References:

1. Larminie, James, and John Lowry. Electric vehicle technology explained. John Wiley & Sons, 2012.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	3	2		3	1					2		2
CO2	3	3	3	2	2		2	2					3		3
CO3	3	2	3	3	2		3	1					3		3
CO4	3	2	2	2	2		2	2					2		2
CO5	2	2	3	2	3		3	1					2		2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

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BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

EECE3651	ELECTRICAL DRIVES AND CONTROL FOR EVS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	EECE3101: Power Electronics						
Co-requisite	None						
Preferable exposure	EECE2091: Linear Control Systems						

UNIT 1 **Introduction to converters** **8 hours**

AC-DC converters (single phase), DC-DC converters: buck converter, boost converter, buck-boost converter, SEPIC converter, Cuk converter, pulse-width modulation techniques

UNIT 2 **Control of dc motor** **8 hours**

Control of a DC motor drive: block diagram of dc motor drive, state space model, speed-torque characteristics, speed control and sensor-less speed control
Control of an induction motor drive: block diagram of an induction drive, state space model,speed-torque characteristics, speed control and sensor-less speed control

UNIT 3 **Control of brushless dc (BLDC) motor** **8 hours**

Block diagram of aBLDC drive, state space model,speed-torque characteristics, speed control and sensor-less speed control

UNIT 4 **Control of a permanent magnet synchronous motor (PMSM)** **8 hours**

Block diagram of a PMSM drive, state space model, speed-torque characteristics, speed control and sensor-less speed control

UNIT 5 **Control of switched reluctance motor** **8 hours**

Block diagram of a SRM drive, state space model, speed-torque characteristics, speed control and sensor-less speed control

Text Books:

1. Ehsani, M., Gao, Y., Longo, S. and Ebrahimi, K.M., 2018. Modern electric, hybrid electric, and fuel cell vehicles. CRC press.
2. Chau, K.T., 2015. Electric vehicle machines and drives: design, analysis and application. John Wiley & Sons.

References:

1. Emadi, A. ed., 2014. Advanced electric drive vehicles. CRC Press.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	3	2		2	1					2		2
CO2	3	2	2	3	3		2	1					3		2
CO3	2	2	3	2	2		3	2					2		2
CO4	3	3	2	2	3		2	1					3		3
CO5	3	3	2	3	3		3	1					3		2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

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BOS: 27-12-2021 **ACADEMIC COUNCIL:01-04-2022**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE4171</td><td rowspan="2">BATTERY MANAGEMENT SYSTEMS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">EECE3101: Power Electronics</td></tr>
</table>

UNIT 1 Introduction 8 hours

Types of energy storage devices: Fuel cells, hydrogen storage systems, and supercapacitors. Types of batteries: Lead-Acid batteries, Nickel metal hydride batteries, Li-S batteries, Li-Air batteries and Li-ion batteries

UNIT 2 Equivalent electrical circuit of a cell Model 8 hours

Various electrical parameters of a cell – voltages, charge, current, energy stored, specific energy, energy density, specific power, energy efficiency, battery temperature, battery life. Equivalent electrical circuit model of a Li-ion cell, derivation of key parameters.

UNIT 3 State of Charge and State of Health 8 hours

Introduction to state estimation – Luneberger observer and Kalman filter. SoC and SoH estimation using Luenberger observer and Kalman filter for simple linear battery model

UNIT 4 Battery charging methods 8 hours

Slow charging and fast charging methods.
Charging Methods - Float Charge, Trickle Charge, Bulk Charge, Equalization Charge
Charging Techniques - Constant Current, Constant Voltage, Constant Current– Constant Voltage

UNIT 5 Battery management System 8 hours

Thermal management – active and passive cooling methods, high-voltage control, safety and protection

Text Books:

1. Xiong, R., 2020. Battery Management Algorithm for Electric Vehicles, Springer, Singapore.
2. Gregory L..Plett, 2015. Battery management systems: Battery modeling. Artech House.

References:

1. Notten, P., Bergveld, H. and Kruijt, W., 2002. Battery management systems: design by modelling, Springer.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3		3	1					3		2
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CO3	3	3	3	2	3		2	2					2		2
CO4	2	3	2	3	2		3	2					2		2
CO5	2	3	2	3	2		3	1					3		2

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SDG No. & Statement:

SDG Justification:

EECE4181	SELF-DRIVING VEHICLE TECHNOLOGY	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	EECE3221: Internet of Things						

UNIT 1 **History of Self-Driving Vehicles** **8 hours**

Brief history of self-driving vehicles and benefits of SDV. Localization based on wheel odometry, INS, lidar, cameras, multi-sensor data fusion.

UNIT 2 **Localization** **8 hours**

Localization with GNSS, GNSS Overview, GNSS Error Analysis, Satellite-Based Augmentation Systems, Real-Time Kinematic and Differential GPS, Precise Point Positioning, GNSS/INS Integration

UNIT 3 **Mapping** **8 hours**

Occupancy grid maps, feature maps, relational maps.
Introduction to Kalman filter, Object detection: feature extraction using scale-invariant feature transform, introduction to simultaneous localization and mapping.

UNIT 4 **Architecture** **8 hours**

Functional architecture: perception, planning, vehicle control. System architecture: hardware layer, middleware layer, application layer. SDV middleware examples: robot operating system, automotive data and time-triggered framework, automotive open system architecture

UNIT 5 **SDV application** **8 hours**

Private passenger cars, public buses, trucks, driverless tractors. Basics of deep learning, applying deep learning for SDVs using semantic abstraction learning and end-to-end learning.

Text Books:

1. Sjafrie, H., 2019. Introduction to Self-Driving Vehicle Technology. Chapman and Hall/CRC.
2. Cheng, H., 2011. Autonomous intelligent vehicles: theory, algorithms, and implementation. Springer Science & Business Media. & Business Media

References:

1. Fallon, M., 2018. Self-driving cars: The new way forward. Twenty-First Century Books (Tm).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2		3	1					2		1
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CO3	2	3	2	2	3		2	2					3		1
CO4	2	2	2	3	2		2	1					2		1
CO5	2	3	3	3	2		2	2					3		2

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SDG No. & Statement:

SDG Justification:

GITAM School of Technology

GITAM (Deemed to be University)

Visakhapatnam | Hyderabad | Bengaluru